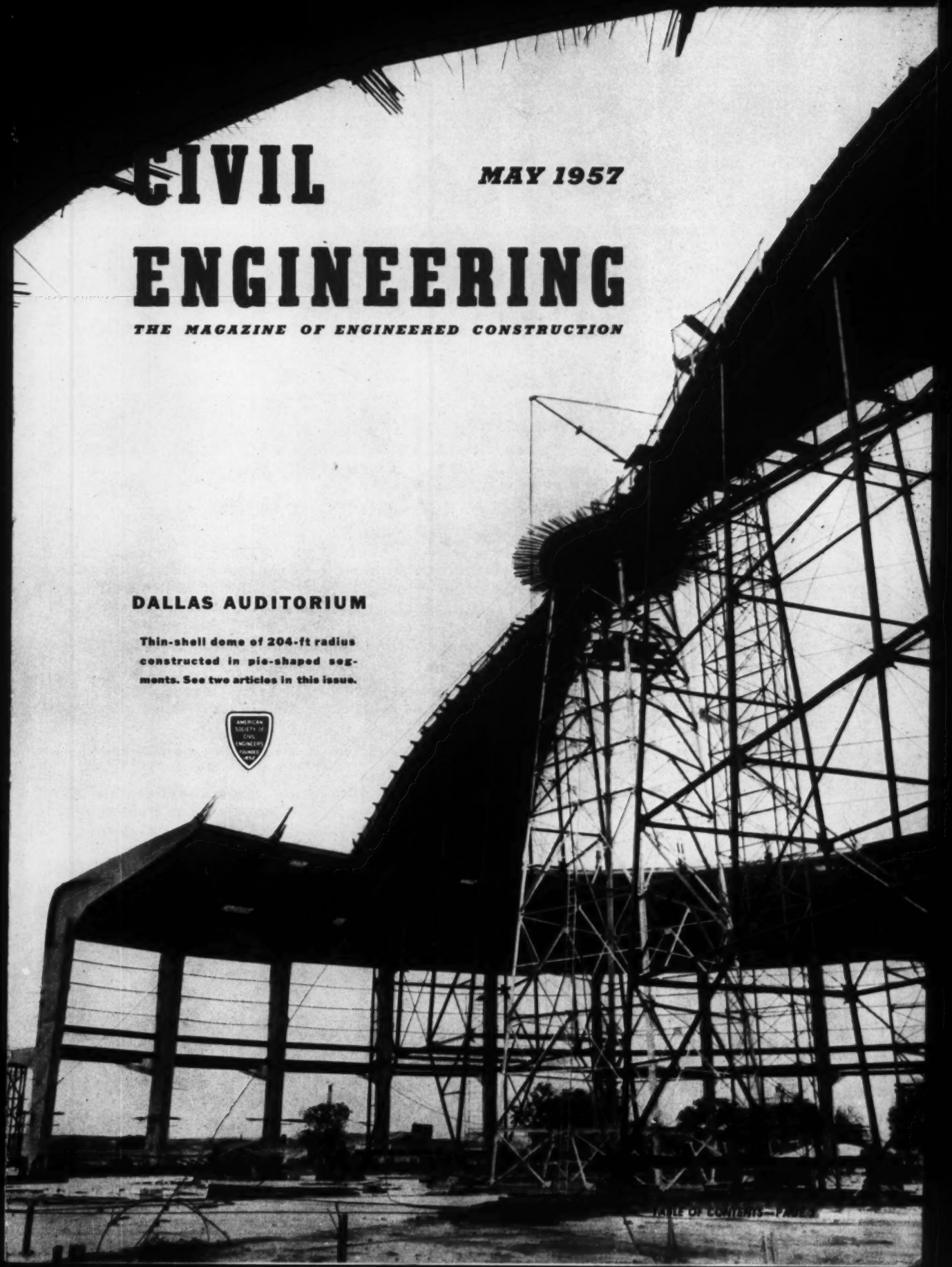
CIVIL ENGINEERING

MAY 1957

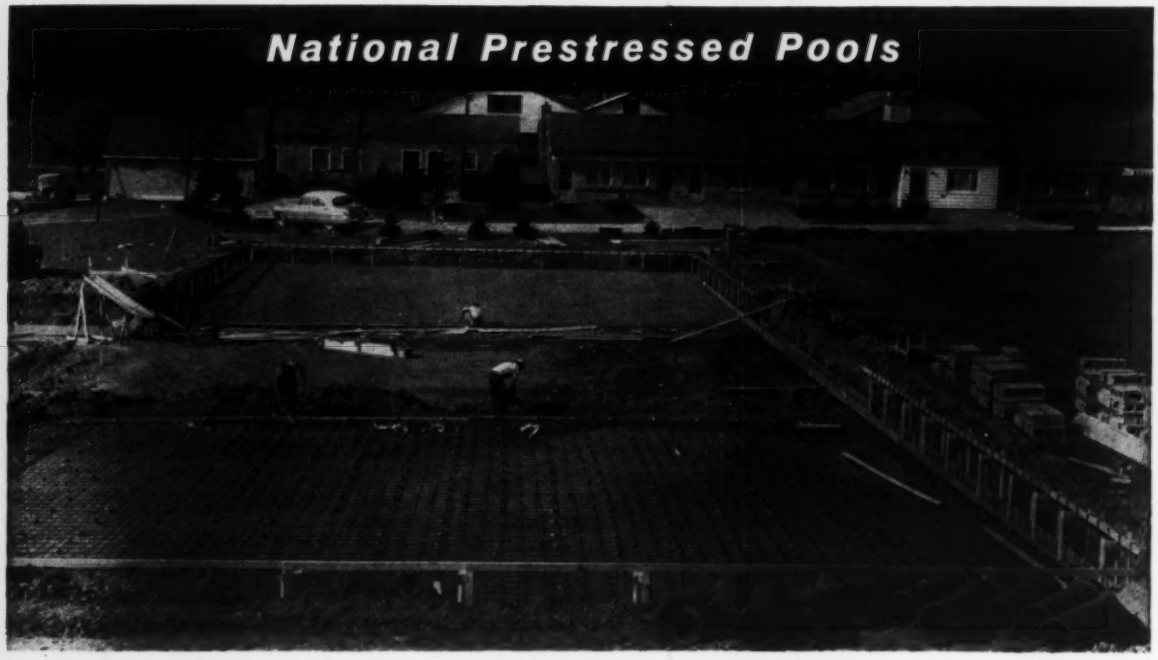
THE MAGAZINE OF ENGINEERED CONSTRUCTION



DALLAS AUDITORIUM

Thin-shell dome of 204-ft radius constructed in pie-shaped segments. See two articles in this issue.

TABLE OF CONTENTS—PAGE 5



One of the largest motel swimming pools under construction at the Blue Spruce Motel, Murrysville, Pa.

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The NATIONAL POOL package includes all fittings special interlocking concrete units, vertical pre-stressing bars, marble-lite material for interior finish and complete filter system. Construction requires no special equipment and can be done with inexperienced local labor. Specially designed pre-cast interlocking concrete wall sections fit into each other and solves cost problem. Pool walls are scientifically pre-stressed to prevent cracking. New method puts swimming pools within reach of all budgets.

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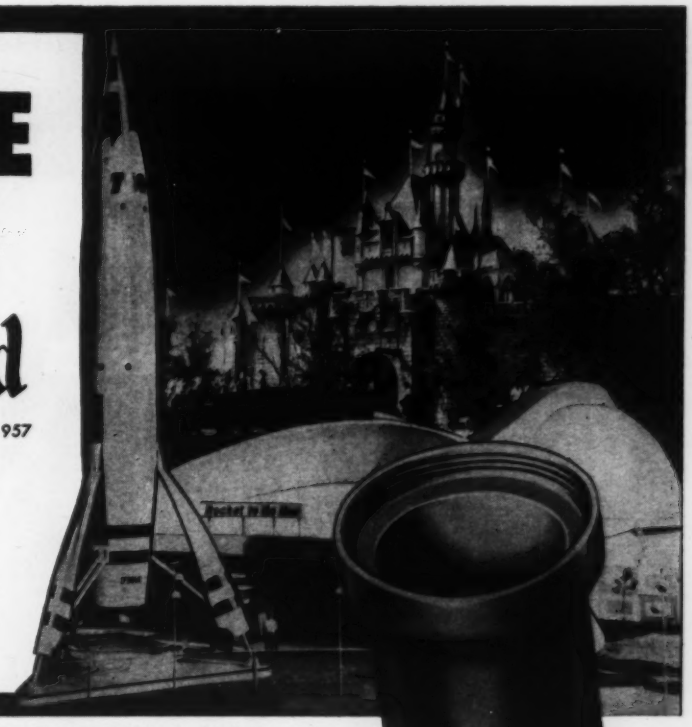

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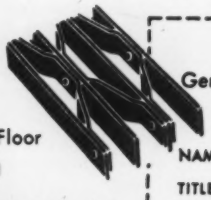

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CIVIL ENGINEERING

MAY 1957
VOL. 27 • NO. 5

THE MAGAZINE OF ENGINEERED CONSTRUCTION

• ARTICLES

Samuel S. Baxter, Myron G. Mansfield — 33 — **Rapid sand filters replace 50-year-old equipment at Philadelphia's Torresdale Water Plant**
Mason G. Lockwood — 38 — **Illusions of leisure**
Elmer B. Isaak — 40 — **New Colombian Railroad will connect capital with Atlantic Ocean**
E. Sherman Chase, John S. Bethel, Jr. — 44 — **Miami high-rate activated sludge plant in operation—Part 2**
Henry F. Soehngen — 50 — **Laying out true meridians in defense plants**
EJC Board of Review — 52 — **Principles of a sound national water policy—a restatement**
58 — **Dallas Memorial Auditorium**
Boyd G. Anderson, Allan D. Anderson — 58 — Cantilevers support dome of 204-ft radius
H. P. Farnsworth, Jr., George J. Sullivan — 61 — Traveling dome forms reduce construction cost
J. K. Finch — 64 — **The engineer through the ages—Greece, Part 1**

• SOCIETY NEWS

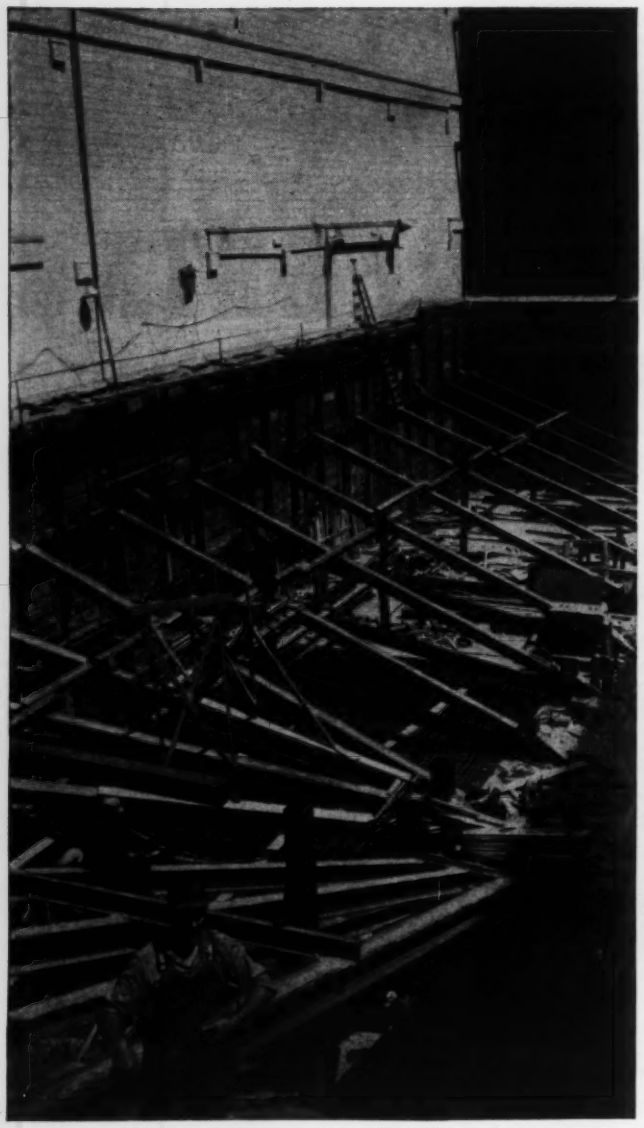
72 — **Last call for Buffalo Convention**
74 — **Hal W. Hunt appointed Executive Editor**
75 — **Robert K. Lockwood promoted to Assistant to Secretary of ASCE**
76 — **Philadelphia Nuclear Congress largest since Geneva**
77 — **New chairmen of ASCE Professional Committees**
79 — **Notes from the Local Sections**
88 — **By-line Washington**

• NEWS BRIEFS

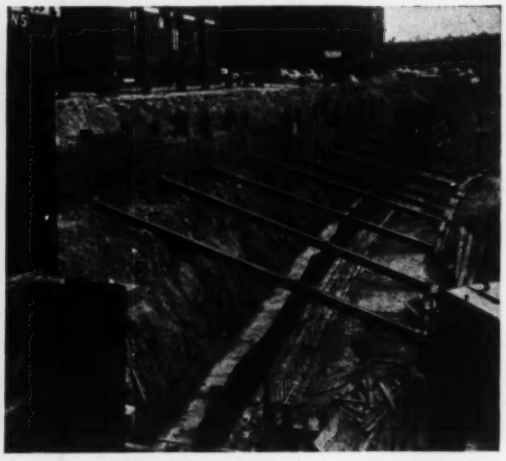
90 — **Construction activity in March advances seasonally**
90 — **Public power test on Hell's Canyon rejected**
92 — **Associated General Contractors meet in Washington**
93 — **New Andes power project to supply Peru refinery**
94 — **Register of Large Dams in U. S. in preparation**

• DEPARTMENTS

24 News of Engineers
29 Am-Soc Briefs
31 Do You Know That
67 The Readers Write
86 Scheduled ASCE Meetings
98 N. G. Neare's Column
100 Deceased
110 Recent Books
122 Men and Jobs Available
124 Non-ASCE Meetings
125 New Publications
126 Applications for Admission
136 Equipment, Materials and Methods
147 Literature Available
149 Films Available
150 From the Manufacturers
156 Index to Advertisers
151 Proceedings Papers Available



Bethlehem H-piles provide lateral support for excavation for railroad tunnel under construction at Salem, Mass. *Contractor:* Farina Brothers Co., Inc.



Construction of Boston's Fitzgerald Expressway included placing of Bethlehem H-piles as soldier beams. *Contractor:* V. Barletta Co.

Soldier beams and bracing support foundation of existing buildings adjacent to new Jordan Marsh Building, under construction in Boston. *Contractor:* Spencer, White, and Prentis, Inc.

Steel H-Piles Used as Soldier Beams on Three Jobs in Massachusetts

For three important construction projects in Massachusetts, Bethlehem H-piles were used as soldier beams in open-cut excavations.

The first job is a portion of the construction of Boston's new Fitzgerald Expressway, a heart-of-the-city superhighway. Here H-piles were driven vertically on the sides of a large open cut during the building of a tunnel and ramps. The piling and its lateral bracing will prevent slides and protect existing foundations and adjacent streets.

Bethlehem H-piles were used in the same way in the construction of the new Jordan Marsh Building in Boston. Here adjacent building foundations were protected by the H-piles together with horizontal timber lagging and lateral braces.

At Salem, Mass., an open cut for a railroad tunnel was also protected by the soldier-beam method. Bethlehem H-piles retained foundations of streets on which traffic continued to move.

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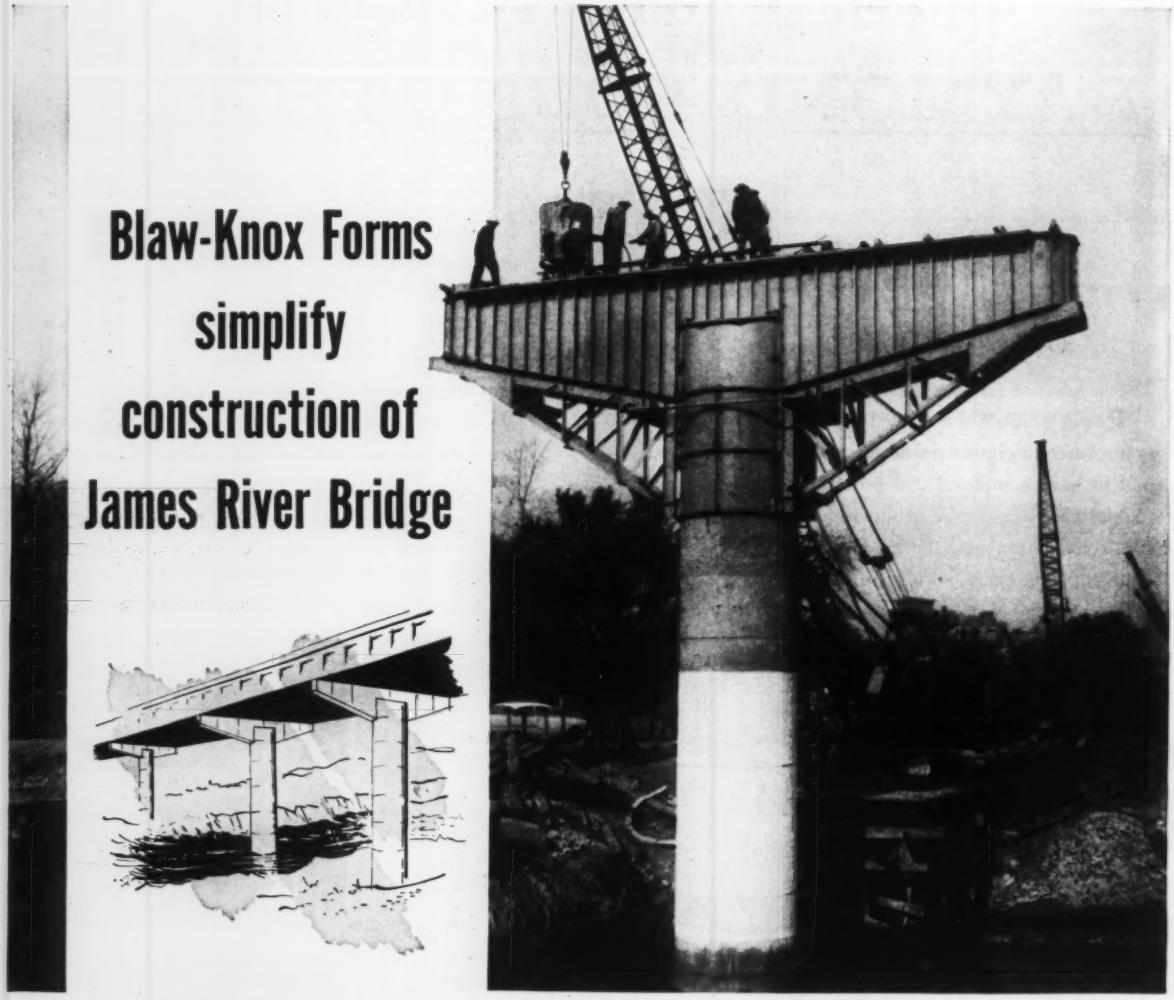
Blaw-Knox Forms simplify construction of James River Bridge



New forming method eliminates guying and shoring • speeds setting and stripping

● A basically new idea in steel column forming for the "T"-shaped substructure of the James River Bridge at Richmond, Va. on the Richmond-Petersburg Turnpike has simplified work for contractors. These specially engineered forms by Blaw-Knox allows the 44-ft. "T"-heads of the substructure to be poured as an integral part of the column without shoring or guying.

Each of the 100 columns on this 6-lane, divided-roadway bridge was poured in 16-ft. and higher lifts. When the reinforced concrete had set all the forms were removed except a 2-ft. lap ring which supported the forms for the next lift. When the "T"-hammerhead is poured a unit of special pier forms supports the bottom and side forms.

After the concrete sets, the side forms are removed ahead of the bottom forms and used on the next column. Due to the varying column heights an adjustable, circular, telescoping form was set on the foundation for the initial pour.

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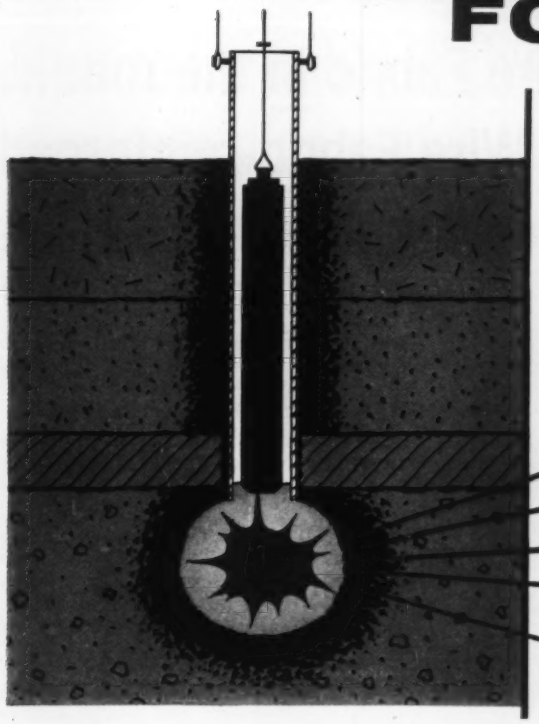

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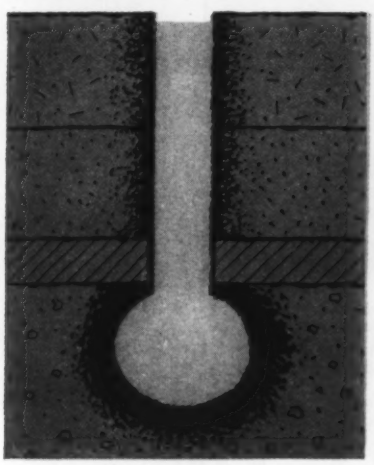

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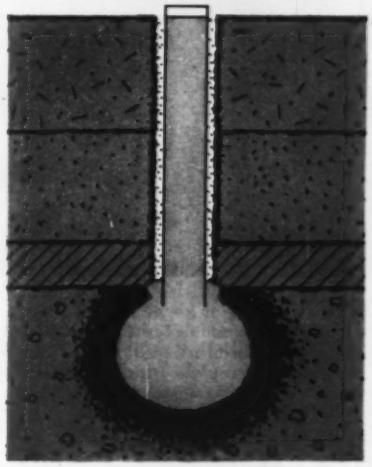

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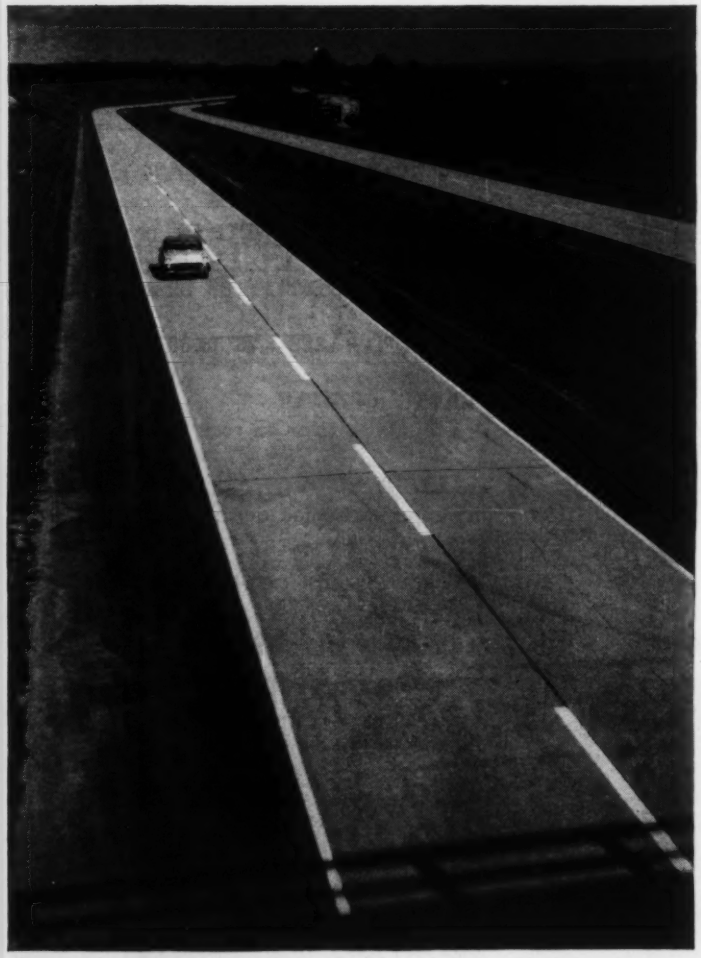

CRACK CONTROL! Since it keeps the road surface smoother, American Welded Wire Fabric helps make the new Indiana Toll Road a *safer* road, as well as a better-riding and more durable road. American Welded Wire Fabric now comes in a complete range of wire sizes up to and including ½" in diameter, 2", 3", 4" and 6" on center.

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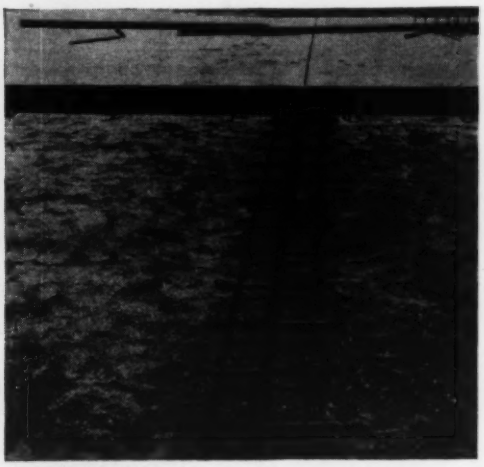

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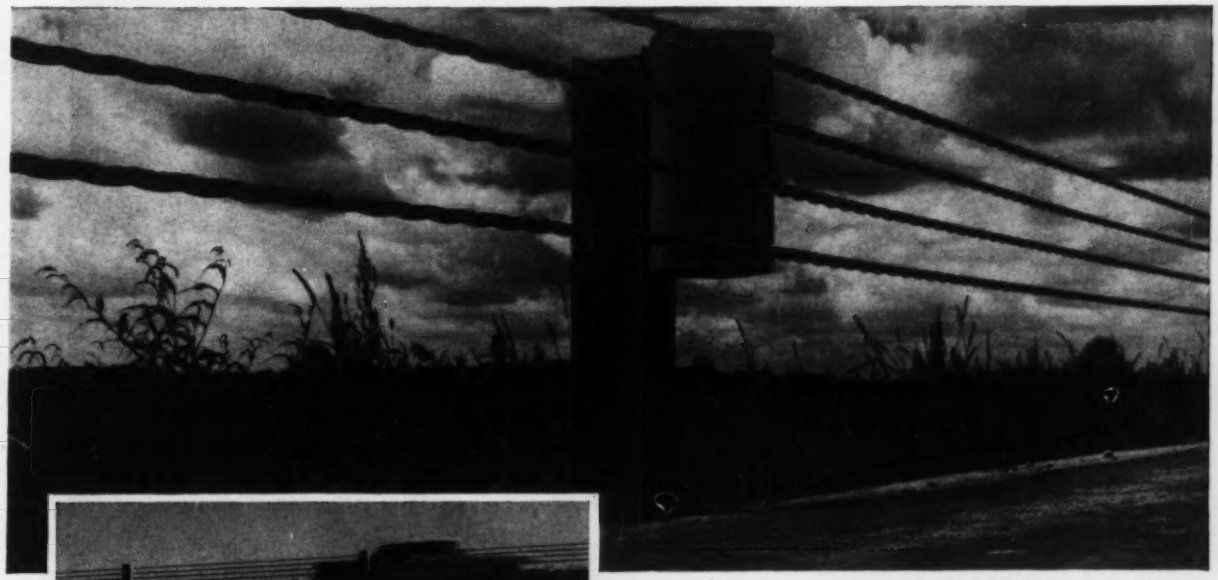

SAFETY, OFF THE ROAD! It is impossible to prevent accidents completely. But here is one way to minimize damage—and injuries: Install American Multisafty Cable Highway Guard along the side of the road, as they did here on the Indiana Toll Road. It is the only guard rail sold that was designed for definite miles-per-hour protection based on extensive testing. The combination of resilient steel cables, plus spring-steel offset brackets, cushions the shock of any collision, and restrains the vehicle, too. American Steel & Wire also makes beam-type highway guard.

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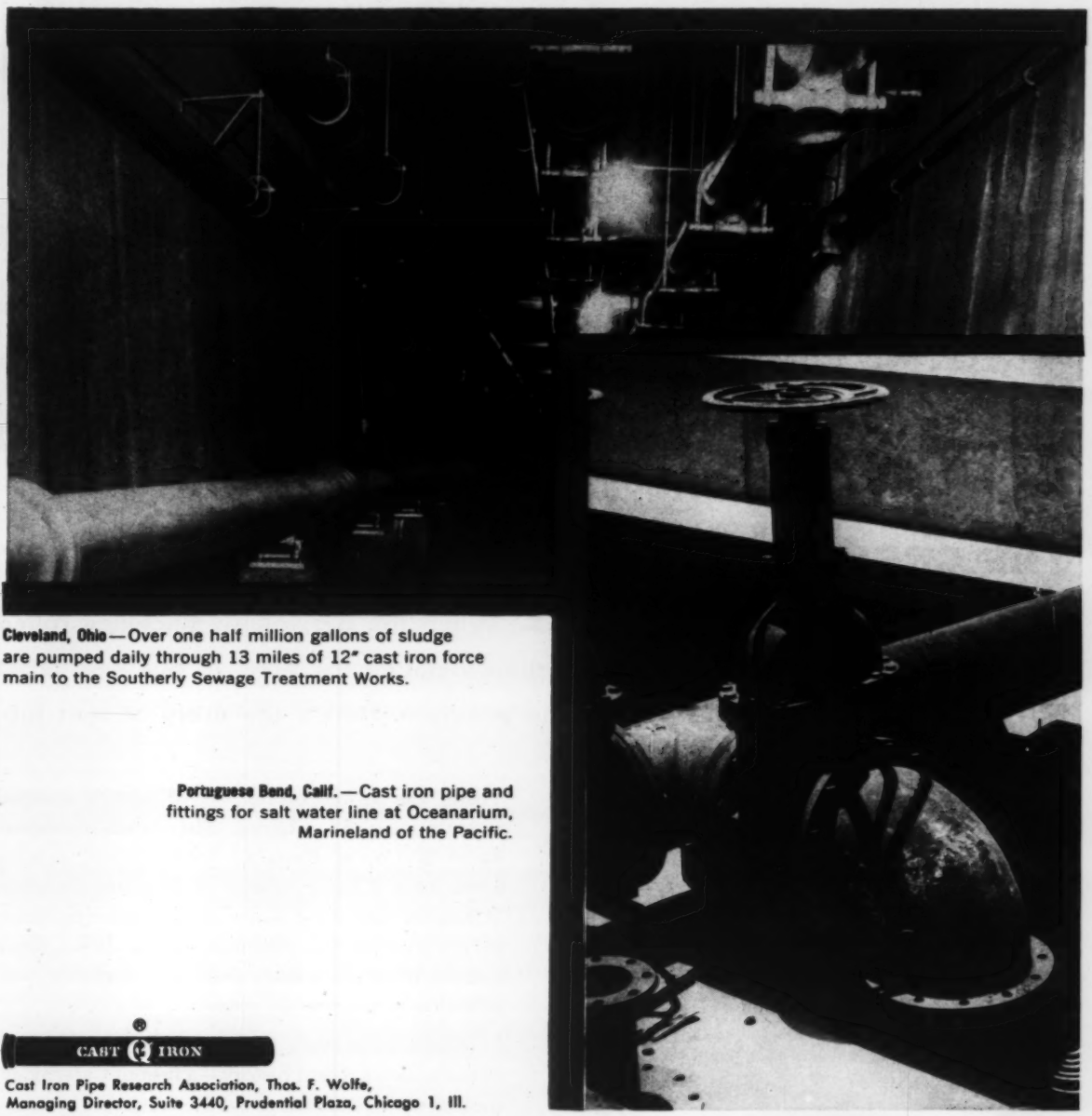

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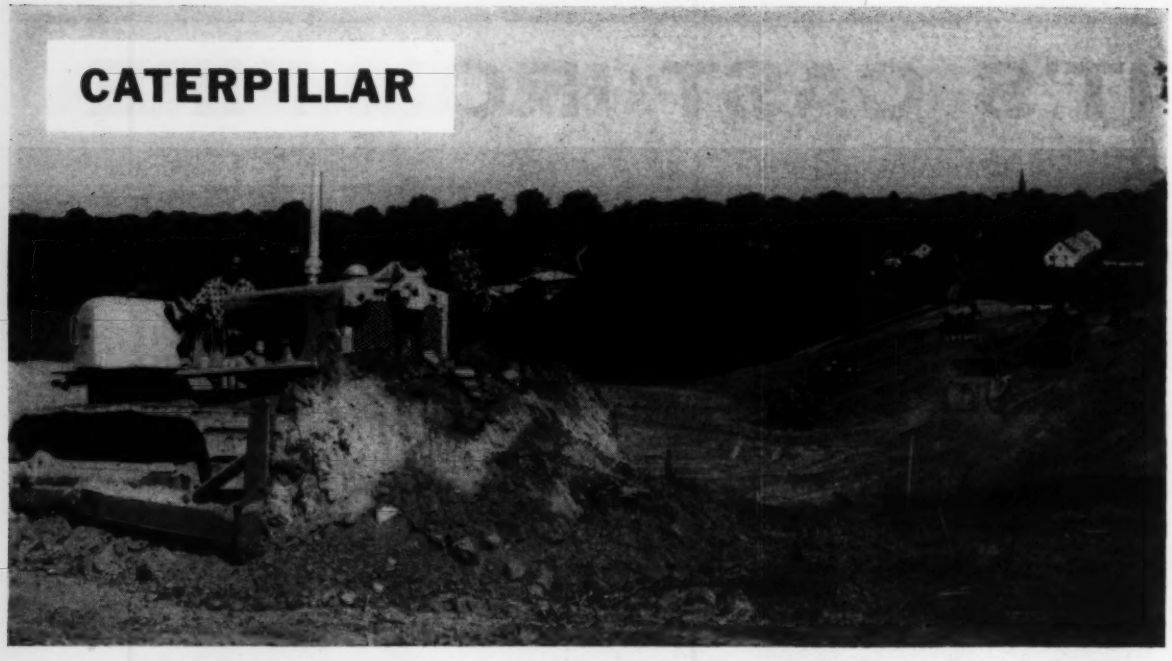

27 CATERPILLAR MACHINES are at work on the historic St. Charles job for Cameron, Joyce & Co.

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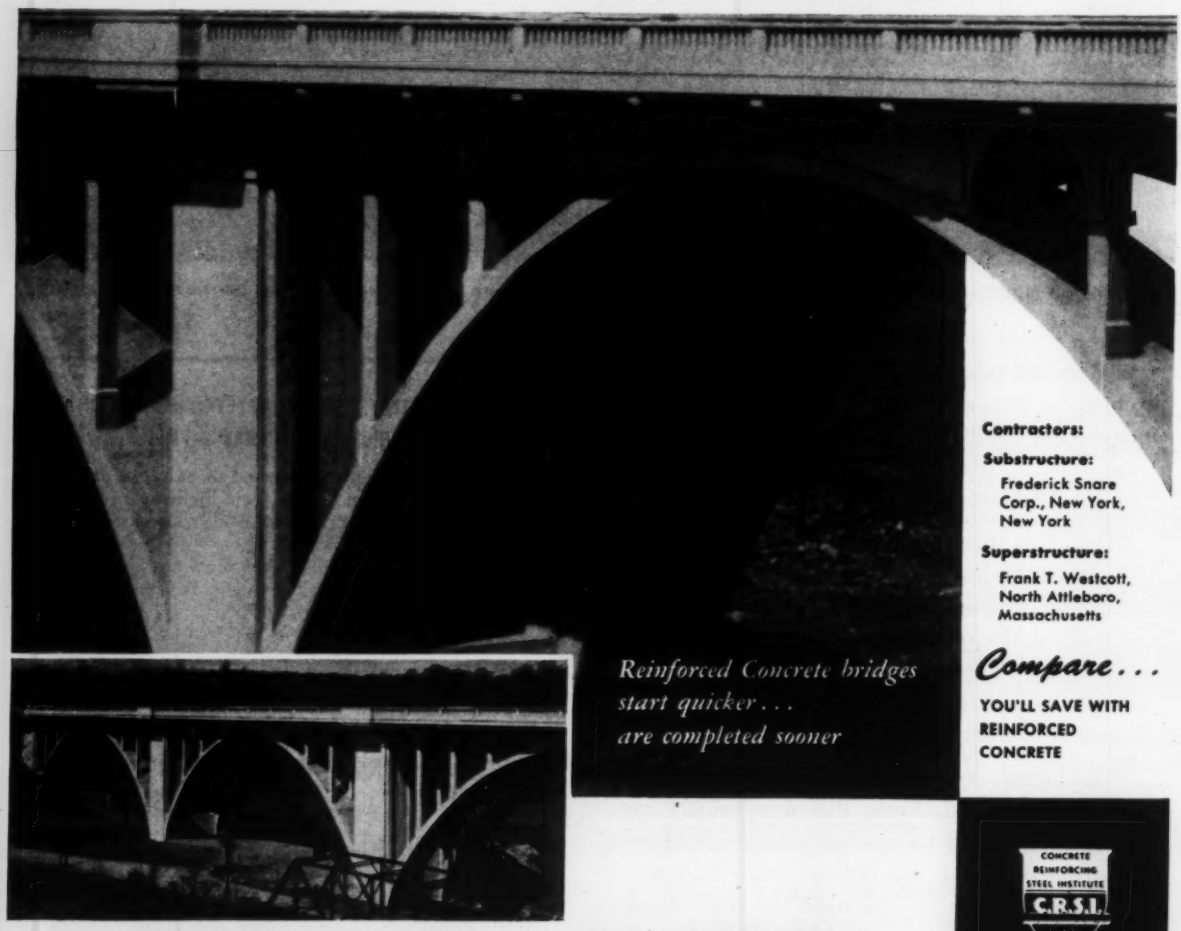

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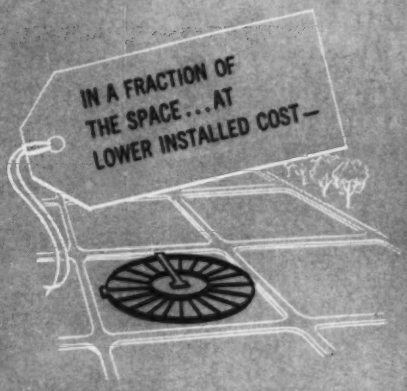

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high rate treatment plant saves up to 80% of space.

Clarifies or softens and clarifies in a *single* basin, replacing separate slow-rate mixing, coagulation and sedimentation basins. Produces clearer, more stable effluent. "Slurry contact," not "sludge blanket" unit.

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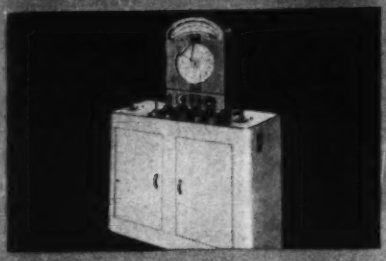

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automatic instruments for pneumatic control of operation.

Most advanced types for sensitive flow control and accurate measurement of loss of head and rate of flow. Contribute substantially to maximum plant efficiency.

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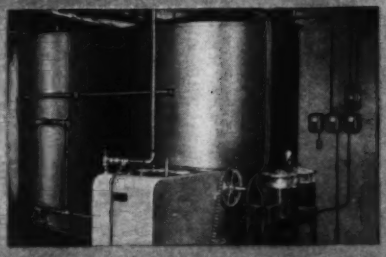

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treating plant... complete in a single unit.

Clarifies or softens and clarifies from 15 to 350 G.P.M. Ideal for small communities, industrial plants, etc. Easy and economical to install.

Bulletin 1870

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provide automatic proportional or constant rate feeding.

Only feeder with linear feed adjustment throughout capacity range of feeder; extrusion type, simultaneous rocking and reciprocal motion to feed pan.

Bulletin 215

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greater efficiency in much less space at much lower cost.

Revolutionary design eliminates costly cooling apparatus and exposed hot gas lines; occupies less than ⅓ space of old style systems. Centralized controls.

Bulletin 1320

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These are only a few of the products for water treatment in the complete INFILCO line, which includes plants and equipment to meet your every need. INFILCO's improved equipment gives you the highest quality production in much less space—cuts construction cost to a minimum—provides you with the most modern installation at lowest total installed cost.

It will pay you to investigate INFILCO equipment. Write today for bulletins of interest to you.

See your Consulting Engineer. If you are planning *any* major installation, the services of a reliable Consulting Engineer can be invaluable. He will design your plant and help you select the type of equipment that best meets your requirements and budget.

Inquiries are invited on all problems in the treatment of water, sewage and wastes for municipalities, institutions and general industry. Complete laboratory facilities available for special treatment problems.

THE ONLY COMPANY impartially offering equipment for ALL types of water and waste processing—coagulation, precipitation, sedimentation, flotation, filtration, ion exchange and biological treatment.

For the beautiful SOUTH

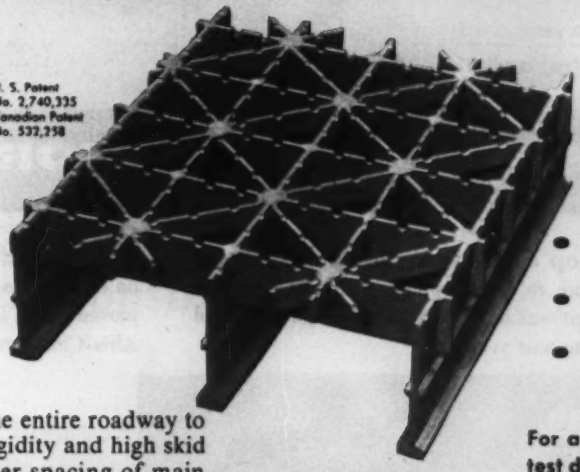
on Maryland's Route 2 leading into Annapolis, the Empire Construction Co., of Baltimore and the Maryland State Roads Commission used Kerrigan's open steel bridge flooring. For the Lanier Bridge at Georgia's Buford Dam, the U. S. Corps of Engineers and Bristol Steel & Iron Works, Bristol, Va., chose it. For the modernization of the famous double-deck Rock Island, Ill. Bridge, Modjeski & Masters, Consulting Engineers, and the F. K. Ketler Co., Chicago, chose it. And for bridges at Raceland, Thibodaux, and New Iberia, La. the Louisiana State Highway Department, F. Miller & Sons, Lake Charles and Austin Bridge Co., Dallas and Baton Rouge, contractors, employed the Greulich 4-Way Grid for strength, economy and a smooth and quiet surface.

As you can see in the picture above, the integrally connected triangles of the Greulich 4-Way Grid provide a flat, single

General Sales Office, 274 Madison Avenue, New York, New York

Flat, single plane surface gives smooth ride and reduces tire hum to a minimum on the South River Bridge. At the same time, the triangular opening in design and scientifically located serrations provide high skid resistance.

The famous Rock Island "double-decker" (just ½ mile from the site of the original bridge made famous by Abraham Lincoln's celebrated defense), will be modernized with Kerrigan's Greulich 4-Way Grid filled half-depth with concrete.



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- **Stronger**
- **Quieter**
- **20% Fewer Welds**

RIVER BRIDGE

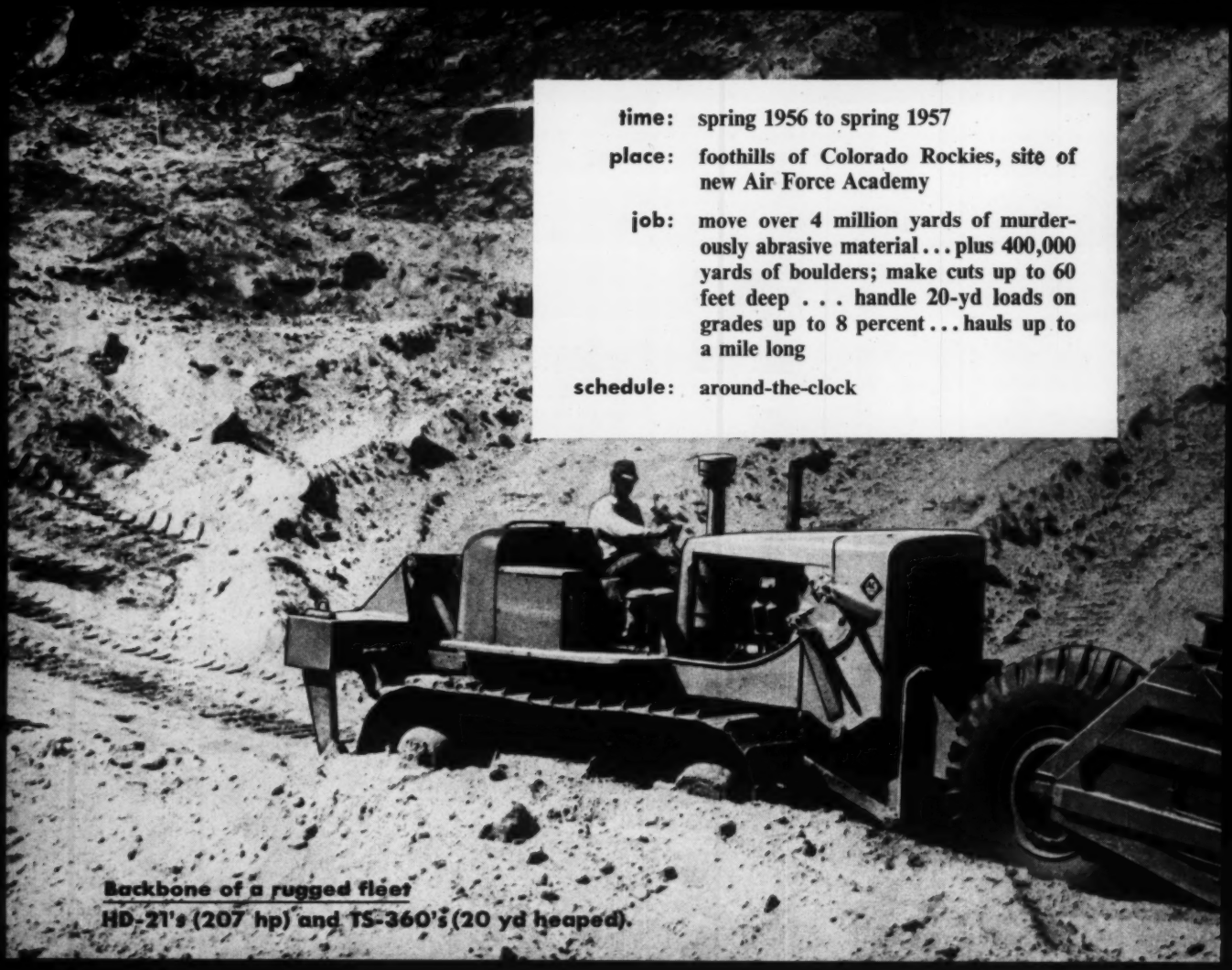
plane, serrated surface extending over the entire roadway to insure maximum lateral or horizontal rigidity and high skid resistance. The 7½-inch center-to-center spacing of main bearing members permits installation with 20% fewer field welds with no loss of strength. The 5-inch deep units are fabricated in panels 7 feet, 3 inches wide to hold handling costs to a minimum and still permit hauling on flat bed trucks. The flooring can be furnished, when there is need, in half-roadway-width units to permit maintenance of one-way traffic at all times where installations are being made to replace old floors on existing bridges. When there is machinery or a street below the bridge floor level, concrete form pans and reinforcement rods can also be provided to allow filling all or portions of grid half depth with concrete. This permits a closed surface and yet holds dead load of flooring to a minimum.

For additional information, test data, and list of bridges you can inspect in Ga., La., Fla., Mass., Ill., Md., Minn., and Penn., write Harvey F. Neel, Mgr., Division G-6, Kerrigan Iron Works, Inc., Nashville, Tennessee.

THE FORGEST OF KERRIGAN

KERRIGAN IRON WORKS, Inc.

Bridge Flooring Division (Harvey F. Neel, Manager), Nashville, Tennessee



time: spring 1956 to spring 1957

place: foothills of Colorado Rockies, site of new Air Force Academy

job: move over 4 million yards of murderously abrasive material... plus 400,000 yards of boulders; make cuts up to 60 feet deep . . . handle 20-yd loads on grades up to 8 percent... hauls up to a mile long

schedule: around-the-clock

Backbone of a rugged fleet
HD-21's (207 hp) and TS-360's (20 yd heaped).

YEAR'S TOUGHEST MOTOR SCRAPER JOB

Cutting as deep as 60 feet into abrasive dirt and boulder-ridden clay, this fleet of Allis-Chalmers machines accomplished what was one of the toughest jobs handled "on rubber" in the past year.

Tough grades, long hauls were part of every cycle on this Colorado Rockies job... but TS-360's consistently moved 20-yd loads fast on haul roads maintained by big Allis-Chalmers Forty Five motor graders.

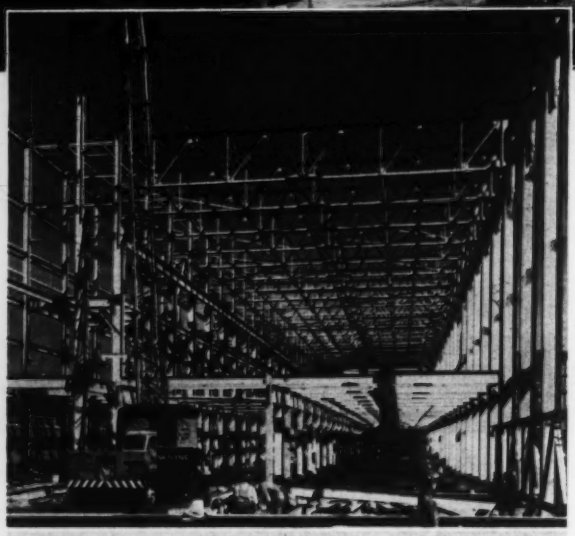
- NOW COMPLETED . . .

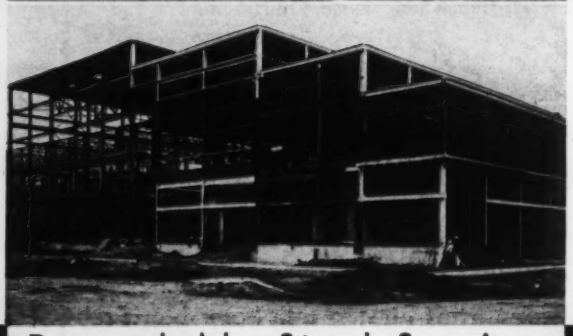
with Allis-Chalmers construction machinery

A more severe test of modern, high-speed earth-moving methods and equipment than this Air Force Academy job would have been hard to devise. Big performance, rugged dependability . . . easy operation . . . simplified lubrication and service made Allis-Chalmers the choice at the start. Now, in spite of rugged operating conditions, that choice has been justified in a job well done. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS *Engineering in Action*

We built a toe-hold for a papermaking monster!





Another service to Southern industry by Bristol Steel!

With the start-up of the third newsprint machine this past January, Bowaters Southern Paper Corporation of Calhoun, Tenn., became one of the largest producers of newsprint in the U. S.

Bristol Steel fabricated and erected more than 3500 tons of structural steel for this expansion, designed by J. E. Sirrine Co., Greenville, S. C.

Our work on this expansion of the Bowaters plant is another example of Bristol Steel's contribution to the growth of industry in the South.

We invite your inquiries for fabricated structural steel requirements. Forty-nine years of experience and the facilities of two modern plants insure dependability to meet the highest standards.

Dependable Steel Service
Since 1908

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BRISTOL STEEL
AND IRON WORKS, Inc.
Bristol, Virginia

STUFFING BOX
Liner design keeps stuffing box unloaded . . . this, plus only 90° rotation of shaft, virtually eliminates leakage.
VALVE BODY
Cast iron flange and body thickness equal to or greater than called for by AWWA Specifications. Standard laying lengths.
VALVE SEAT
Molded natural rubber (or similar material) reinforced with stainless steel inserts . . . cemented and screwed in place for complete immobility. Permits valve relocation without difficulties encountered with spool-type liner valves.
TWO-WAY THRUST BEARING
Keeps valve disc centered regardless of valve position and absorbs any unbalanced axial thrust developed by static pressure acting on the valve shaft.
SOLID STAINLESS STEEL SHAFT

REDUCE MAINTENANCE COSTS

with Builders Butterfly Valves

Available with all types of manual and power operators, including Builders own "lo-head" cylinder operator.

Strict adherence to sound engineering and advanced hydraulic principles accounts for the high durability of Builders Butterfly Valves. These design features, plus extra-sturdy construction result in valves which last the life of the plant and require minimum maintenance.

Remember, too, that these Butterfly Valves are backed by Builders specialized knowledge of water and sewage works metering and control problems. Builders Butterfly Valves are built to AWWA specifications . . . for water and sewage works service.

For Bulletin 650-L1B, write
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DIVISION OF
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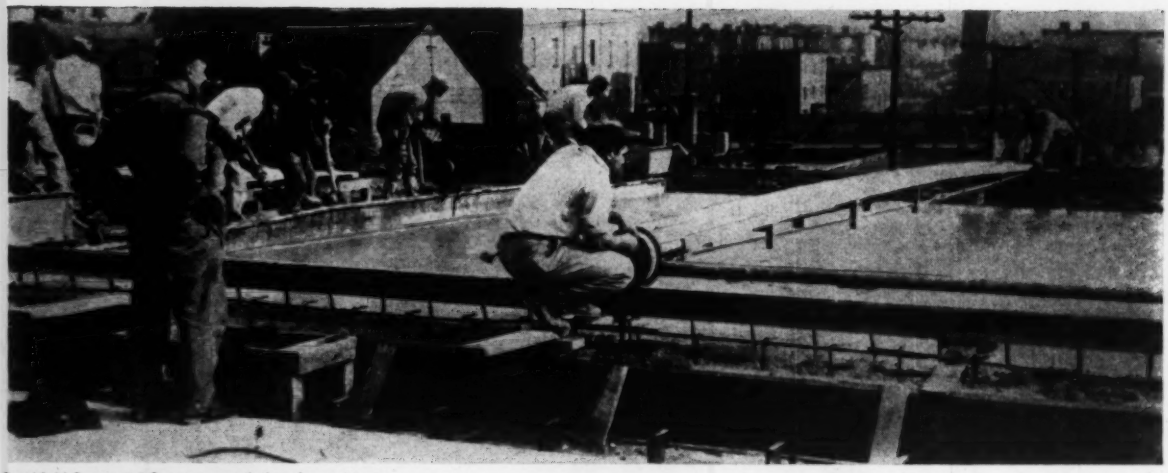
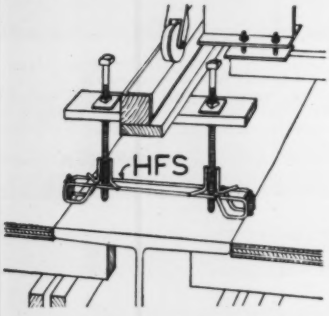


Brookfield Construction Company screeds three lanes at once.

Skillful screeding, Richmond supports, pay off in fast, accurate slab finishing

A new screeding technique developed by Brookfield's superintendent, Jack Sorensen, paid off handsomely on this elevated highway extension of the New Jersey Turnpike. An 800-lb., 36-ft., vibrating screed blade was used, with supporting angle-covered 3 x 4's held firmly in place every 7-ft. by Richmond Hanger Frame Screed-Rail Supports. This made it possible to screed three lanes in one operation. Besides gripping the rail with extra firmness, the Richmond bases permitted the heights to be set exactly—from the top—with simple screw-head adjustments.



Brookfield's new technique and insistence on Richmond Screed Supports are typical of the emphasis on proper slab finishing among progressive contractors. Good screeding means a lot more than producing a good looking slab. For, unless the surface is finished without dishes or highspots and with design level maintained, the slab will not drain properly and will not satisfactorily resist weather and wear. In order to maintain levels, screed rails must be accurately positioned and held, so that they will not move during pouring and finishing. That is why the construction industry is showing such preference for Richmond Screed Supports with their adjustability and extra strength.

Equally important to good screeding, is having rail supports that are exactly suited to the job and to the screeding equipment to be used. The Hanger-Frame type used by Brookfield is only one of the complete line of Richmond Screeds.

In both the Richmond Standard Series and the special Series D supports, there is a wide range of sizes, weights and models. There are Richmond supports for use with hand screeds and vibratory screeds, and adaptable to power equipment. There are also Richmond heads to match any rail, whether pipe, T-bar, or special shape.

Whatever the type or size, all Richmond screeding devices, form brackets, and form and curb bolts provide the extra strength that not only saves money but ensures a better job. A number of the Richmond supports are shown at right. You will find all of them, and all Richmond screeding items, fully described in a new handbook just published—along with the full line of Richmond-engineered concrete tying devices, anchorages, and accessories. For your copy, or for help on any specific type of concreting problem, write: RICHMOND SCREW ANCHOR COMPANY, INC., 816 Liberty Ave., Brooklyn 8, N. Y. or 315 So. Fourth Street, St. Joseph, Mo.

A FEW OF THE MANY TYPES OF RICHMOND SCREED-RAIL SUPPORTS

Richmond Adjustable Screed Chairs come in both the Standard (½" dia.) and D (¾" dia.) Series. Opposing legs that interlock and cannot spread or bend assure even distribution of load. Two new heights, 7½" and 10", have been added in the Standard Series. For unusually thick slabs, there are Richmond Special Height Screed Chairs.

Richmond Offset Screed Chairs have built-in support to take cantilevered load when rail must be placed above surface, as, for instance, when reinforcing steel runs opposite to screeding direction. Richmond Offset Screed Head can be quickly adjusted from above with speed wrench; is double-ended for use with either pipe or T-rail.

Richmond Fill-Type Adjustable Screed Base, used when slab is over soft fill, provides stability with four extended legs driven into ground. Richmond Sub-Grade Stake (not shown) does similar job for heavier loads below grade.

Richmond-Sub-Grade Base provides 2"-high support with unequal bearing plates. It is used mainly with shorter screed bolts or as base for form bolt. Sub-Grade Chairs (not shown), 3½" to 18" high, are also available for soft sub-grade fill.

Richmond Form Bracket, can be nailed to a joist to support a screed bolt extending through the decking. May also be used in conjunction with a curb bolt to support and position a curb form. Consists of a ½" or ¾" coil welded to a steel plate equipped with four nail holes.

75 Years of Progress

A world-wide organization ready to serve you

In May, 1882, Mahlon E. Layne drilled his first water well, thus beginning an organization that would become world-wide and world-famous. He designed the Layne Vertical Turbine Pump, Layne Shutter Screen and Layne Gravel Wall Well. These are recognized today for their combined unfailing performance in producing water for the world.

Layne has always accepted the challenge of leadership. Engineering advances and research have guided our organization from the beginning. This is the pattern which has earned Layne the reputation for world-wide leadership. We owe this leadership to the trust our valued customers have placed in our organization.

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Stuttgart, Arkansas

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LAYNE-CENTRAL COMPANY
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INTERNATIONAL WATER CORPORATION
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75 YEARS OF PROGRESS

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WATER WELLS • VERTICAL TURBINE PUMPS • WATER TREATMENT

NEWS OF ENGINEERS

Robert B. B. Moorman, since 1952 professor and chairman of the department of civil engineering at Syracuse University, has been appointed head of the civil engineering department at the Polytechnic Institute of Brooklyn. In his new capacity, Dr. Moorman will succeed Edward J. Squire, who retired last September. Before going to Syracuse Mr. Moorman was professor of civil engineering at the University of Missouri for 17 years. He has been president of both the Mid-Missouri and Syracuse Sections of the Society.

Walter K. Wilson Jr., Brigadier General, Deputy Chief of Engineers for Construction, U. S. Army, has been promoted to the rank of Major General. The promotion went into effect on March 25. General Wilson has been an officer in the corps of Engineers since graduating from the United States Military Academy in 1929.

John W. Clark recently became assistant chief of the engineering design division at Alcoa's Research Laboratories in New Kensington, Pa. Mr. Clark, author of several publications on the strength of beams and columns, has been with Alcoa since 1947.

Theodore F. Collier, who since 1950 has been in charge of the civil-structural engineering division of Westcott and Mapes, New Haven, Conn., recently was elected vice president of the firm. Since 1954 Mr. Collier has been project engineer for the joint office of Westcott and Mapes and Seelye, Stevenson, Value and Knecht, New York City consulting firm.

Perry J. Goldman, president of the Perry J. Goldman Construction Co., Philadelphia, received a citation of honor from Drexel Institute of Technology at its recent Alumni Honors Assembly held during the organization's 65th anniversary convocation. Mr. Goldman received the citation for "personal, civic and professional achievements."

Gail A. Hathaway, Past-President of ASCE, has been appointed an engineering consultant in the Department of Technical Operations of the World Bank, Washington, D. C. Mr. Hathaway has just retired as Special Assistant in the Office of the Chief of Engineers. He was with the Corps of Engineers from 1928 until his retirement, and had been in the Office of the Chief of Engineers since 1938.

Gail Hathaway

An authority in hydraulics and hydrological engineering, Mr. Hathaway has represented the United States on many international commissions, and is currently president of the International Commission on Large Dams.

Dwight A. Chase, Captain, U. S. Coast Guard and commander of the Second Coast Guard District at St. Louis, Mo., will retire in June after 36 years in Government service. Before entering the Coast Guard service in 1939, Captain Chase had been in the U. S. Lighthouse

Recognize these landmarks?

The photos below were taken by Fairchild Aerial Surveys crews on routine flights.

They suggest the broad range of services offered by Fairchild: detailed photomaps for the city planner, magnetometer surveys for the geologist, and topographic maps for the mining and civil engineers.

For more than a quarter century Fairchild has been used by engineers and exploration men in every part of the world to save time and money.

The next time you need an aerial survey fast, and right the first time call Fairchild.

1.

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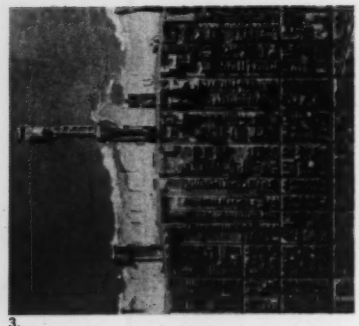

3.

4.

1. San Andreas Fault, California
2. Randall's Island, New York City
3. Atlantic City, New Jersey
4. Quarry at Fairfield, Alabama

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Service and the U. S. Bureau of Public Roads. He was assigned as chief of staff of the Second District in 1954, and became commander in April 1956. He has had the rank of captain since 1945.

John W. Roberts was elected president of the National Ready Mixed Concrete Association for 1957 at the organization's Annual Convention held in Los Angeles in February. Mr. Roberts is vice-president and official representative of the Southern Materials Company, Inc., of Richmond and Norfolk, Va. He is past-president of the Virginia Section of ASCE.

John W. Roberts

Jacob Birk Spiegel, staff engineer on special reports and investigations for the U. S. Geological Survey, Topeka, Kans., retired in February after 43 years of service. Mr. Spiegel's long tenure with the Survey includes 31 years as head of the Topeka office. For the past five years he has been collecting data on overflows of Kansas rivers since the state opened for settlement.

Herbert D. Nickerson has joined the Philadelphia district sales office of the Dravo Corporation, Pittsburgh. He will represent Walker Process Equipment, Inc., as a sales engineer for industrial water and waste treatment equipment. Previously Mr. Nickerson was a sanitary engineer with the Massachusetts Department of Public Health.

Russell C. Brinker, head of the civil engineering department at Virginia Polytechnic Institute, has completed his naval service and retired as a Rear-Admiral in the Civil Engineer Corps of the U. S. Naval Reserve. Professor Brinker is the 60th officer in the 89-year history of the Corps to attain two-star rank, and the 11th Reserve Officer.

Russell C. Brinker

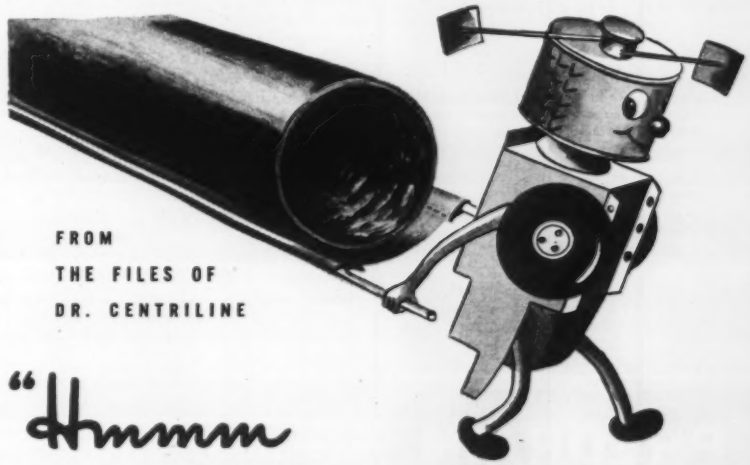
Joseph L. Benson and **Charles G. Daley** announce their association for the practice of gas and electric rate engineering and economics, under the firm name of Daley and Benson, public utility consultants. Headquarters of the new firm will be in Washington, D. C.

Marshal McCord has joined the consulting firm of Green Associates, Baltimore, Md., as chief of the Structures Section. For the past eleven years, he has been with the J. E. Greiner Company, Baltimore, as design engineer, project engineer and resident engineer on bridge and highway projects.

James C. Marshall, Brigadier General, U. S. Army (retired), for the past two years with the New York engineering firm of Tippetts-Abbett-McCarthy-Stratton, is being transferred by that firm to Paris as project manager of a new undertaking. The firm has entered into a joint venture with Ommium Lyonnais, a French engineering firm, to design and supervise construction of an ore-transport system in French Equatorial Africa.

Samuel Hobbs, field engineer with the Portland Cement Association, Los Angeles, has retired after 33 years with the organization. Mr. Hobbs will engage in consulting work on concrete and continue magazine writing on concrete construction projects.

R. Dale Hodges is now manager of the new Baton Rouge office of Pan-American Engineers, consulting engineers of Alex-



"Hmmm ... a bad case of corrosion"

CASE #7841

PATIENT:	8 Miles of 16" and 12" Cast Iron Water Supply Lines in Abington-Rockland (Mass.) Water District.
SYMPTOMS:	Lack of water and pressure during periods of high demand requiring restrictions in the summertime.
DIAGNOSIS:	Poor circulation due to regrowth of tuberculation after cleaning. Available water could not be delivered to consumers.
TREATMENT:	The lines were cleaned and cement lined in place without interrupting service to consumers. In less than 8 weeks the entire job was completed.
RESULTS:	Patient now sound and healthy; pipe capacity permanently doubled, no further summer restrictions, future maintenance costs were eliminated.

If your lines also show signs of suffering from corrosion, leakage or tuberculation, investigate the Centriline Process. Cleaning and cement lining in place has been a successful remedy for over 1,000 miles of water supply pipelines. Centriline hasn't lost a patient yet.

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IT'S HANDY...
weighs only 9 oz.; 2¾" x 3" x 1⅛"; easy to carry in pocket, on belt, in car.

IT'S VERSATILE...
ideal for preliminary and supplementary surveying; used as a compass, transit, level, plumb, alidade, clinometer.

IT'S MADE TO LAST A LIFETIME
Shows direction to 1°; level, slope or grade within 1°.

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andria, La. The new office is located at 3415 North Acadian Thruway, Baton Rouge, La. Before joining Pan American Engineers two years ago, **Mr. Hodges** was with the Army Corps of Engineers in New Orleans and French Morocco.

L. C. Bishop has retired as state engineer of Wyoming after serving in that capacity under six governors and longer than any other engineer in the state's history. He was one of the first registered engineers in the United States, and was honored with an LLD degree from the University of Wyoming in 1952. After an extended vacation in Hawaii, Mr. Bishop will return to Cheyenne to map and reestablish the immigrant trails across Wyoming for the State Historical Department.

D. E. Westervelt has joined Kaiser Engineers, Oakland, Calif., as principal engineer. Prior to his new connection Mr. Westervelt served as special assistant to the Administrator, General Service Administration, Washington, D. C. He will make his home in Walnut Creek, Calif.

Ralph Fifield, chief engineer of the Montana State Water Conservation Board, Helena, has retired. He was in the service of the state for 51 years, principally as an irrigation and drainage engineer.

Neal B. Garver (right), construction engineer of Little Rock, Ark., receives a citation as Arkansas Engineer of the Year. The presentation is being made by A. M. Lund, M. ASCE. Now in semi-retirement at 80, Mr. Garver is credited with having designed and built more bridges than any other person in the state, and having drawn structural plans for "countless steel and concrete buildings." Mr. Garver is former chief engineer of the Arkansas State Highway Department, and past-president of the Mid-South Section of ASCE.

Ruben N. Bergendoff, consulting engineer of Kansas City, Mo., is one of four engineers who received the Missouri Honor Award for Distinguished Service in Engineering from the University of Missouri at a special convocation held during Engineers' Week. Mr. Bergendoff, a member of the Firm of Howard, Needles, Tammen and Bergendoff, was cited for his "outstanding achievements in the design of long and short span bridges; his valuable contribution to the development of modern highway turnpikes, expressways and interchanges; and his untiring service in the advancement of the engineering profession and to civic enterprises."

Robert J. Haefeli, on the staff of the Bureau of Reclamation for the past nine years, has returned to Denver, Colo., after four years on leave of absence in Lebanon with the International Cooperation Administration. While there, Mr. Haefeli was an adviser to the Lebanese Government in programming engineering designs and estimates for irrigation, water supply and power projects.

Greeley and Hansen, consulting engineers of Chicago, Ill., announce the addition to their partnership, as of January 1, of **George M. Hite, Donald Newton, Carl W. Reh,** and **M. D. R. Riddell,** for many years staff members of the firm.

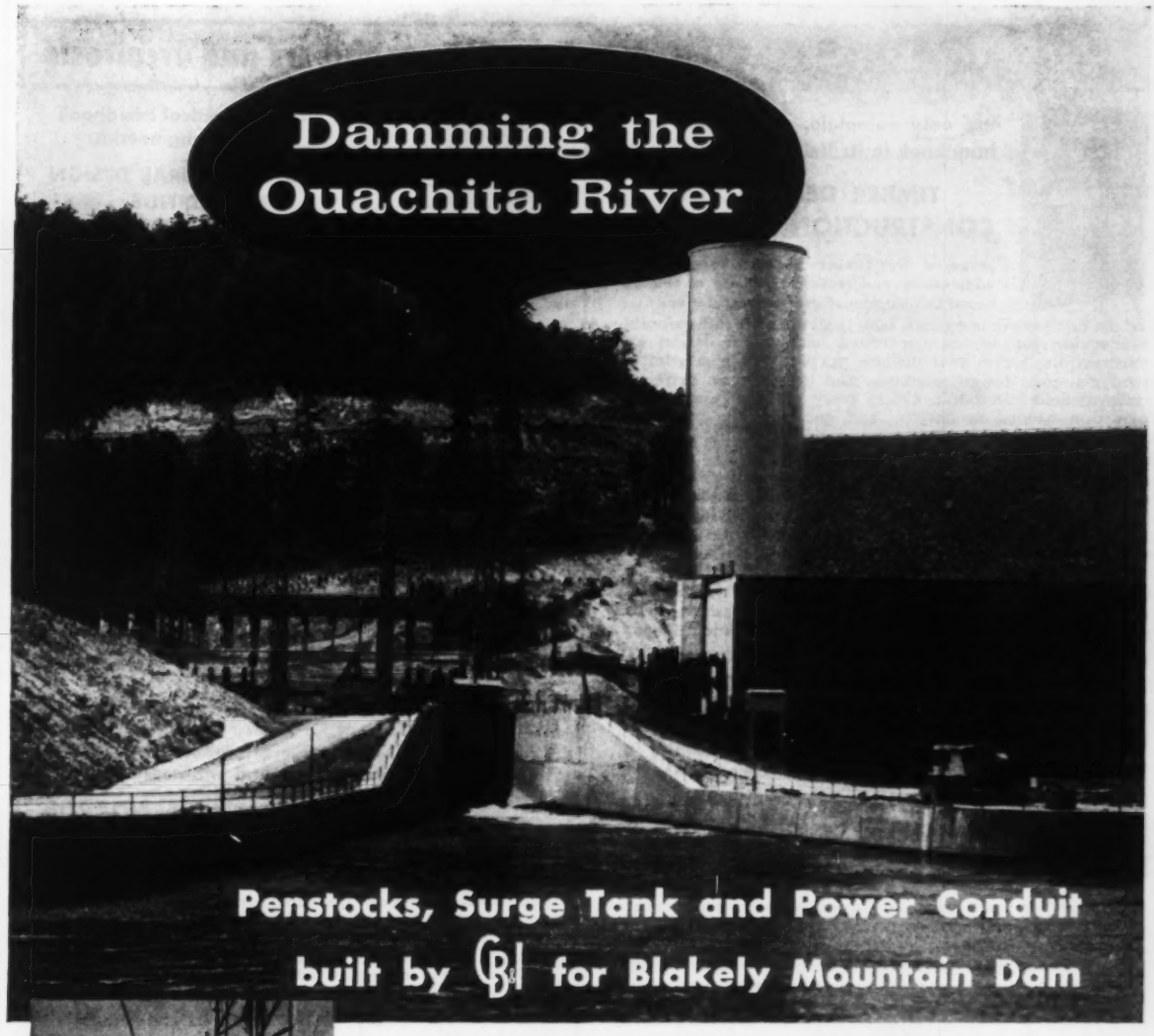
The following engineers have been appointed associates of the firm of Seelye Stevenson Value & Knecht. In the Civil Engineering Division: **Williams D. Bailey;** in the Structural Engineering Division: **Frohman P. Davis, Ira M. Hooper, Frederick J. Kircher, Philip P. Page, Jr.,** and **Wayman C. Wing;** and in the Mechanical and Electrical Division: **William T. Cleland, Jack N. Keck,** and **Alexander Michelson, Jr.** All have been with the firm for many years.

Loring K. Himelright was recently appointed head of the civil engineering department at the Citadel, Charleston, S. C. Major Himelright has been on the Faculty since 1943 as an assistant professor, then associate professor. His new position carries the title of professor of civil engineering. Major Himelright is also a soil mechanics and foundation engineering consultant for Soil Consultants, Inc. of Charleston.

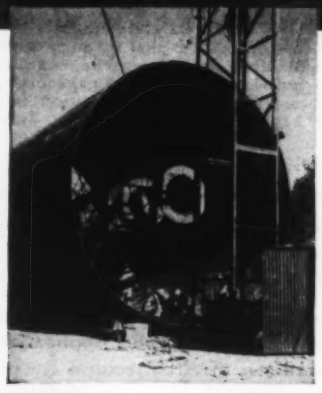
George W. Pracy retired in March as general manager and chief engineer of the San Francisco Water Department. Mr. Pracy entered city service in 1930 when San Francisco purchased the privately owned Spring Valley firm, and had been general manager and chief engineer since 1949. As manager of the department he has supervised the construction of hundreds of miles of water pipeline, including the new Sunset supply line and the Hillsborough Tunnel. Friends and associates of Mr. Pracy honored him with a large dinner on March 28.

(Continued on page 98)

Damming the Ouachita River



Penstocks, Surge Tank and Power Conduit built by CB&I for Blakely Mountain Dam



Section of one of the penstocks fabricated and assembled by CB&I at Blakely Mountain Dam near Hot Springs, Arkansas.

CB&I fabricated and erected 17-ft. and 16-ft. diam. penstocks, a 55-ft. diam. by 149-ft. high surge tank and a 24-ft. diam. power conduit for Al Johnson Construction Company, Minneapolis, Minn., at the Blakely Mountain Dam, Arkansas. The dam, built for the Corps of Engineers, U. S. Army on the Ouachita River near Hot Springs, is a project of the Vicksburg District Corps of Engineers.

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. . . . . Am-Soc Briefs

▶ ▶ The Society's 1957 salary survey is well along. As soon as statistical analysis of the returns is complete the results will be summarized in "Civil Engineering." Supplementary up-to-the-minute information—based on consulting and highway department salaries—will be available in the new quarterly Engineering Salary Index (April issue, page 80).

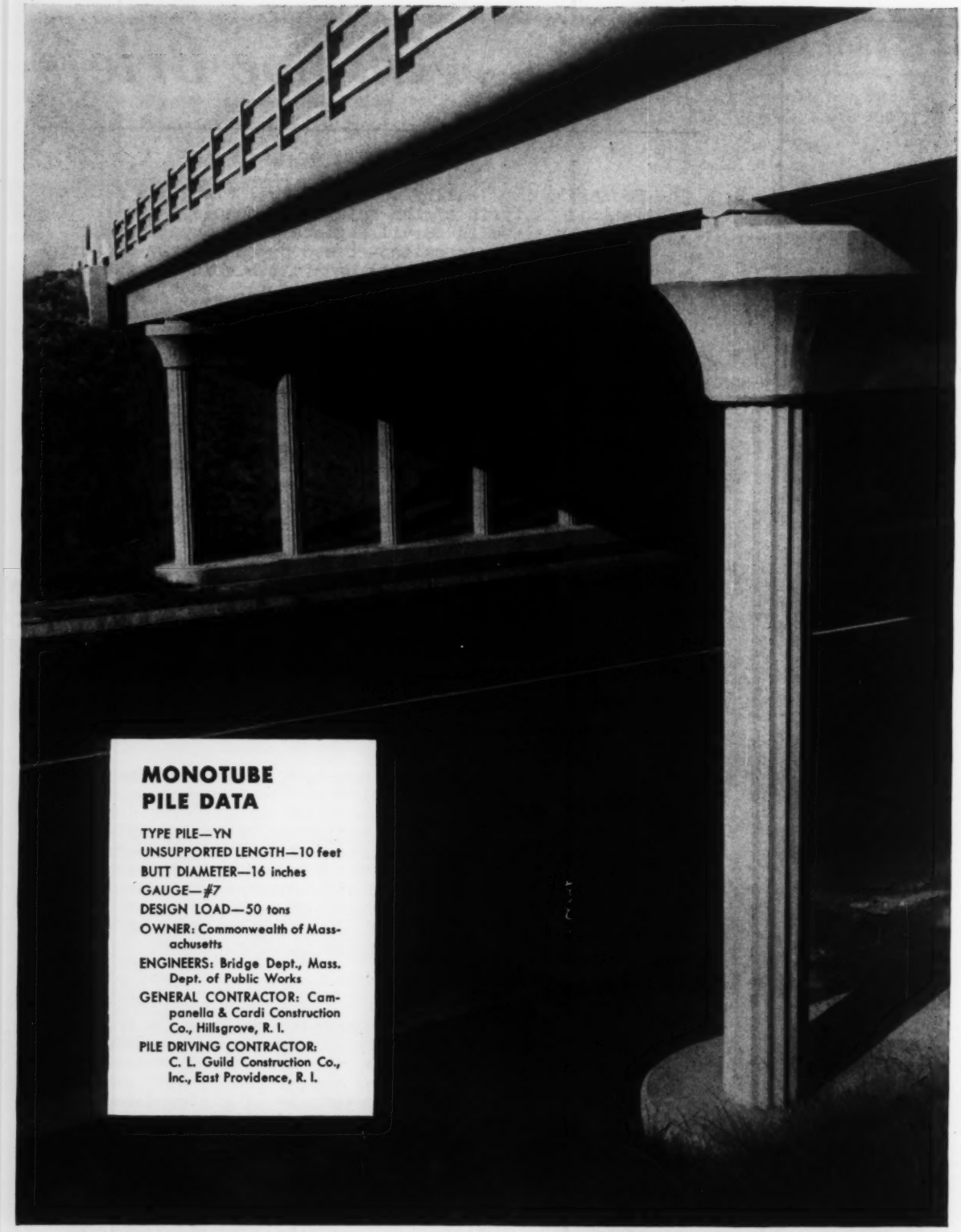
▶ ▶ Sanitary Engineers . . . note that the deadline for receipt of applications to be considered for certification without examination has been extended. This extension was adopted to permit members of AIChE, recently voted a sponsor of the American Sanitary Engineering Intersociety Board, to take advantage of the possibility of certification without examination. Engineers certified by the ASEIB automatically become members of the American Academy of Sanitary Engineers.

▶ ▶ Principles of Interprofessional Practice between architects and engineers were approved by the ASCE-AIA Joint Cooperative Committee early in April. While this is an important first step toward closer cooperation, the principles of course are still a long way from adoption by the two groups. Incidentally, EJC has approved setting up a joint cooperative committee with AIA, which would absorb the functions of the joint committees of all the design professions.

▶ ▶ Off to a good start are two new ASCE technical committees. One of these—a joint committee of the Structural Division and the American Concrete Institute—is studying composite construction in bridges and buildings, with emphasis on steel beams with concrete slabs and on precast concrete beams with cast-in-place slabs. The other, a Pipeline Division committee, is concerned with obtaining a standard for pipeline crossings of railroads and highways. . . . This newest Division issued its first technical journal this spring, and another issue is due in June.

▶ ▶ Speaking of publications . . . there is a revised and corrected edition of Manual of Engineering Practice No. 10, "Technical Procedure for City Surveys," published in 1934. To bring it up to date, the new edition takes cognizance of the growing use of aerial photography and photogrammetry, and increasing acceptance of state plane-coordinate systems. It also outlines the variety of maps used in city planning work and relates them to the basic surveys and maps of the regular city survey schedule. To make ordering easy there is a coupon on page 128. . . . The Committee on Engineering Education's 16-page booklet, "You Can Be a Civil Engineer," is proving a helpful recruiting guide. Aimed at the junior high school level, it may be obtained from the Executive Secretary without charge.

▶ ▶ At headquarters . . . With this issue Hal W. Hunt becomes executive editor filling the vacancy created by the appointment of Robert K. Lockwood as Assistant to the Executive Secretary (pages 74 and 75).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PILE DATA
TYPE PILE—YN
UNSUPPORTED LENGTH—10 feet
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OWNER: Commonwealth of Massachusetts
ENGINEERS: Bridge Dept., Mass. Dept. of Public Works
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Cantilever-supported domes are gaining in popularity? Newest example of this spectacular ultramodern construction is a 10,000-seat auditorium, focal point of the Dallas Memorial Center, set for completion this June. Design features and unusual construction methods are highlighted in two articles in this issue.

• • •

India is a major challenge to the sanitary engineer? Of its 73 cities with population of over 100,000 only 23 have sewerage systems. Taking the country as a whole, only about 3 percent of the population is served by sewerage systems, and only about 6 percent by protected water supply systems. This is the challenge presented in a forthcoming article by an American engineer, A. C. Ingersoll, A.M. ASCE, who recently returned from a year as guest professor at Bengal Engineering College.

• • •

Auto exhaust and refuse burning are the prime offenders in the Los Angeles battle against smog? Reporting for the Air Pollution Foundation, Managing Director W. L. Faith notes that, while auto exhaust cannot yet be controlled, the "answer to the incinerator problem is the cut-and-fill method of disposing of refuse." Results of legislation against refuse burning—the deadline is October 1—are already apparent in decreased smog, the Foundation finds, despite a jump in population, more industry, and more cars.

• • •

New York is smog-conscious, too? Plans for the most comprehensive study of air pollution ever carried out in the New York-New Jersey metropolitan area are announced by Seth Hess, M. ASCE, director and chief engineer of the Interstate Sanitation Commission. The first attempt ever made to solve the problems of a bi-state area, the program will include an investigation of the extent to which smoke, dust, and other pollutants drift back and forth between the states. The Weather Bureau, Public Health Service, and other government groups will cooperate.

• • •

Oklahoma has chalked up another turnpike? When the Will Rogers Turnpike (connecting the Turner Turnpike with the Missouri border) is opened this May, it will afford motorists making the 2,107-mile trip between Oklahoma City and Augusta, Me., 1,877 miles of four-lane divided highway. The fact that 1,387 miles of the route can be driven on toll roads without stop lights will make the trip still easier. These figures, quoted from the *Tulsa Tribune*, were supplied by DeLeuw, Cather & Company, consultants on the Will Rogers Turnpike.

The St. Lawrence Project gives promise of breaking all construction safety records? This is the opinion of construction safety engineers for Employers Mutual of Wausau, which reports that to date there have been no fatalities on the contracts they have insured (totaling 90 percent of the work). Twenty-five years ago, they note, one fatality for each million dollars of construction was regarded as almost inevitable, and disabling injuries were four times their present rate.

• • •

The Florida Road Department is eliminating failures in prestressed concrete bridge members? Early designs and methods of construction resulted in near collapse of some structures. In an early issue W. E. Dean, M. ASCE, assistant state highway engineer, tells how corrections were made and recommends specific means for the future. Florida has found prestressed concrete economical and prefers it for many structures.

• • •

Young talent is badly needed in the atomic energy field? In the next two years the atomic power field alone will need 10,000 trained men and women, according to Walker L. Cisler, president of the Detroit Edison Company and of the Fund for Peaceful Atomic Development. Speaking at the first National Science Youth Day Dinner, Mr. Cisler also brought out the fact that, "the potential sources of nuclear energy are probably more than 23 times greater than all known conventional fuels."

• • •

A new type filter may pave the way to more effective treatment of waste? The new device—designed by Karl Schulze, assistant professor of civil engineering, Michigan State University (East Lansing, Mich.)—eliminates the clogging problem common to crushed stone filters. Instead of stone, the new filter consists of vertically suspended wire grids so spaced that clogging cannot occur. A pilot plant treating normal sewage and dairy wastes has been operating the past year at East Lansing.

• • •

Engineering graduates in 1956 fell below the predicted figure? More than 10 percent below, the Office of Education reports. However, the total number of graduates (31,621) was well above the 1955 total of 27,547. Cause for optimism, too, is the fact that enrollments are rising—77,738 freshman enrollments for the 1956-1957 academic year as against 72,825 for 1955-1956. Making allowance for the high rate of attrition, graduations may reach 44,000 in June 1960.

Factory-Made Heavy-Duty Pavement

Precast, Prestressed 'Incor' Concrete Pavement Slabs Used in Widening New Jersey Approach to 3-Tube Lincoln Tunnel

● Completing the 3rd Tube of Lincoln Tunnel and its complicated approaches without traffic interference is an outstanding achievement. Typical of how The Port of New York Authority engineers public convenience into such projects is the North Bergen, N. J. Approach Viaduct widening.

Poured-in-place concrete would have tied up traffic. Precast, prestressed paving slabs were the public-serving answer. A total of 263 5-in and 6-in. slabs, respectively 20 ft. x 6 ft., and 10 ft. x 20 ft., were used. Fast, economical installation again confirmed the advantage of quality members, fabricated to closest tolerances, under factory-controlled conditions.

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CIVIL ENGINEERING

RAPID SAND FILTERS

replace 50-year-old equipment at Philadelphia's Torresdale Water Plant

SAMUEL S. BAXTER, M. ASCE

Water Commissioner and Chief Engineer, City of Philadelphia, Pa.

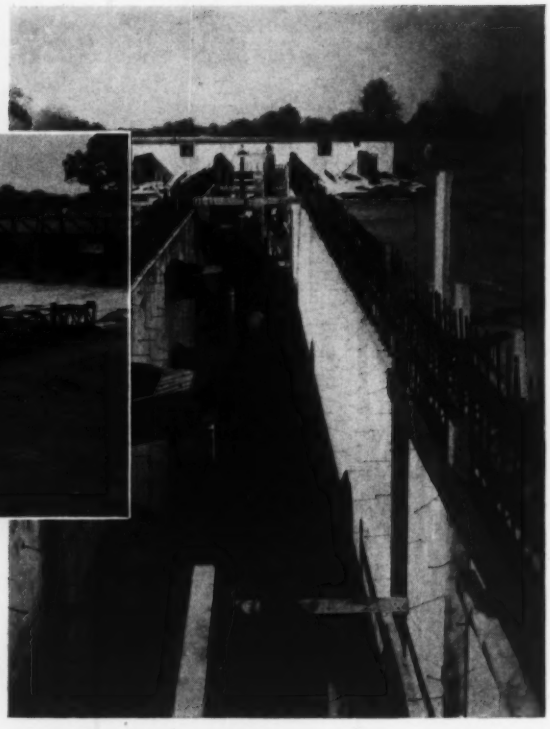
MYRON G. MANSFIELD, M. ASCE

Consulting Engineer, Morris Knowles, Inc., Pittsburgh, Pa.

Philadelphia's Torresdale Water Treatment Plant is located on the Delaware River just inside the northerly city line and about 11 miles upstream from Market Street. See map, Fig. 1. The present treatment consists of coagulation by application of chemicals and mixing, presedimentation, prechlorination, preliminary or roughing filtration in mechanical filters, final filtration in slow sand filters, and post chlorination. About half the water used daily in the city is produced by this plant.

Presedimentation is carried out in a basin on the bank of the Delaware River. A dike separates this basin from the river proper, and the level of the water in the basin rises and falls with the tide. At the northerly or inlet end of the basin are the tide gates, baffled mixing chamber, and chemical building, where alum and lime are applied as coagulants by dry-feed machines automatically controlled by a differential gage at the basin inlet.

Rates of flow into the basin vary from zero at low tide to nearly 600



Above: Workmen complete erection of clarifier arm for sedimentation basin No. 2. Arm is 174 ft 6 in. in total length and will clean about two-thirds of basin area. Right: Hangers and saddle for pipe conduits are being installed in dry well of sedimentation basin No. 1. Conduits carry effluent from sedimentation basin to rapid sand filters.

mgd at high tide, when pumping from the basin is at an average rate of 200 mgd. From the two basin outlet conduits, six motor-driven centrifugal pumping units, each with a capacity of 50 mgd, pump the water to 120 preliminary or roughing mechanical filters, each having a rated capacity of 2 mgd. Raw water can also be pumped from an intake located directly on the river. The raw water is chlorinated in the main intake conduit to the pumping station. Effluent from the preliminary filters is discharged by gravity onto 65 slow sand filter beds, each having an area of about 0.75 acres. Their combined total rated capacity is 200 mgd. Effluent from the slow sand filters flows by gravity into a clear-water basin having a capacity of 50 million gal, and to the Torresdale filtered-water pumping station. Water from the filtered-water reservoir flows by gravity through about 13,000 ft of 10-ft tunnel to the Lardner's Point filtered-water pumping station. Effluent from the slow sand filters is chlorinated in the conduit between these filters and the clear-water basin.

The present plant units were constructed and placed in operation about 1911 with the exception of the electric-driven raw-water pumps, which were installed in 1926 to replace earlier steam equipment. Thus the old plant will have been in service nearly half a century by the time the new plant is ready to begin operation.

Existing plant outgrown

The decision to build a new plant was based on several factors. First was the fact that the present plant has to operate at full capacity during the high-demand periods of summer and during certain other periods in winter. The growth of the city, and especially of the area served by the Torresdale Plant since its construction, has placed a strain on the present facilities.

During many high-demand periods the pumping stations delivering water into the system from the Torresdale Plant have been deliberately throttled in order to conserve filtered water. This practice is of course undesirable, and as recently as September 1956 was criticized by the National Board of Fire Underwriters, with the result that Philadelphia has been penalized in its fire rating.

Another factor was the long-range plan for abandoning the Shawmont Intake and Pumping Station on the Schuylkill River, together with the Roxborough Filter Plant, the area they now serve to be supplied from the Torresdale and Queen Lane plants. This plan will add about 12.3 million gal daily to the Torresdale demand.

These considerations, together with the fact that the Torresdale Plant is about fifty years old and one of the few large slow sand filter plants still in operation, led to the decision to replace it with a modern rapid sand plant which would adequately meet present-day needs as well as future requirements for at least 25 years.

The original design, which called for double filtration, with preliminary or roughing filters ahead of the slow sand filters, was based on the condition of the raw Delaware River water. When the plant was first placed in partial operation in 1907, no sewage in Philadelpha was treated and some of the pollution moved with the tide upstream to the intake. There was also upstream pollution that reached the intake.

For many years after the plant was placed in operation, the sanitary condition of the Delaware River deteriorated. Sewage from an increasing population reached the river untreated, and a number of large industries discharged wastes into it directly. This was the situation in 1940 when the studies were made and the report presented recommending construction of the present new work at Torresdale. At that time it was contemplated that the existing preliminary filters would be abandoned but that the effluent

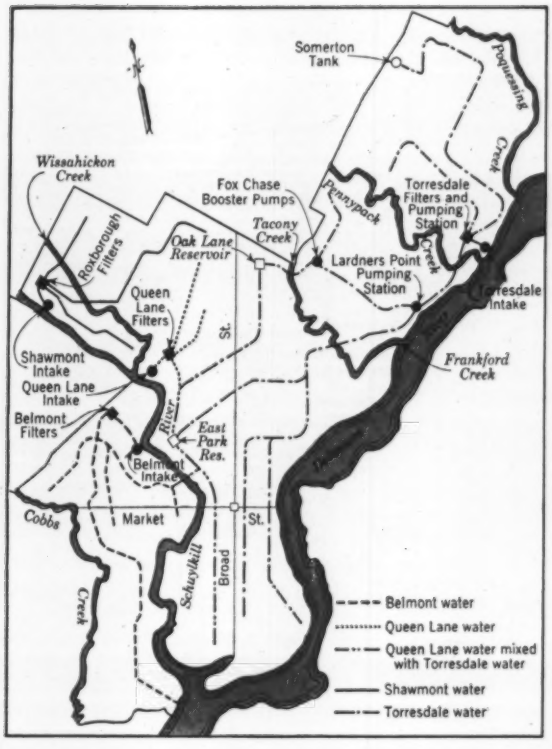


FIG. 1. Philadelphia's Torresdale Filter Plant supplies water to northeastern and eastern sections of city. Reconstructed plant will provide 282 mgd for an enlarged area.

from the new rapid sand plant would receive polishing treatment in the existing slow sand filters.

The war and other circumstances postponed the start of construction until 1954. By that time the stream clean-up program of Pennsylvania and New Jersey was making rapid progress. The Philadelphia Sewage Treatment Program was nearly completed, upstream cities had built new treatment plants, and most industrial wastes had been removed from the river. Because of these factors, the original program to use the existing slow sand units as polishing filters has been abandoned by the city.

Major problems involved

The major problems involved in treating Delaware River water are the pollution load and the taste and odor characteristics. Except for these difficulties, a highly satisfactory water can be produced by a conventionally designed rapid sand filtration plant. In the past, tastes and odors have presented a particularly difficult problem as a result of highly concentrated industrial wastes reaching the intake. Because of these characteristics of the raw water, special provisions have been made in the design of the new plant to safeguard the finished product.

In hardness the raw water fluctuates between 50 and 85 ppm, with an average of about 55 ppm. Since in this area a hardness of 50 ppm is considered soft, the raw water is generally acceptable in this respect.

Yearly averages of the turbidity of the raw water are generally below 45 ppm. However, monthly averages have been as high as 220 ppm, and individual readings as high as 2,800 ppm have been recorded. In these unusual cases, the present presedimentation facilities will function to reduce the turbidity load to such an extent that no special modification of the conventionally designed plant will be required.

The new plant will utilize as many of the existing units as possible. Double filtration will be replaced by a modern new rapid sand plant completely equipped for maximum flexibility in chemical application and control and for adequate pretreatment, and provided with special facilities to combat high pollution loads and taste and odor problems. The only unit of the present plant to be abandoned in its entirety will be the preliminary mechanical filters. The present slow sand filters will be converted into a filtered-water reservoir, thus increasing the filtered-water storage at Torresdale by about 150 million gal. The new plant will have a capacity of 282 mgd at a design rate of 2 gal per sq ft per min, and a maximum of 423 mgd at a design rate of 3 gal per sq ft per min.

The present preliminary sedimentation or tidal basin will be continued in use, but the application of coagulation chemicals at the inlet will be discontinued in normal operation. However the present chemical feeding equipment will be retained for emergency use. Chlorine will be applied at the inlet as normal operating procedure, and provision will be made for the addition of chlorine dioxide for taste and odor control when required.

Raw water will be pumped from the preliminary sedimentation or tidal basin by the existing motor-driven centrifugal pumping units, augmented by additional ones, all housed in the present raw-water pumping station. This water will pass through about 3,000 ft of twin concrete conduits of 96-in. diameter to the preliminary treatment works located northeast of the present slow sand filters and between them and Linden Avenue.

The raw water pumped to the preliminary treatment plant will be measured by Venturi meters installed in the conduits adjacent to the Chemical Building, their readings being utilized for control of chemical feeding. The preliminary treatment works will consist of structures and equipment for the application of chemicals, rapid and slow mixing, and coagulation and sedimentation.

Chemical Building

The Chemical Building, a five-story structure with basement, will house, on the basement level, two raw-water conduits leading to eight rapid mixing basins, two liquid-alum storage tanks, four carbon slurry tanks, electrical control equipment, and chemical unloading, feeding and other miscellaneous equipment. Provisions are being made for the use of liquid alum in addition to powdered alum. The lead-lined storage tanks for it are being constructed as a part of the chemical building substructure.

On the first or ground floor of the Chemical Building there will be areas for a maintenance shop, boiler room, employees' quarters, and chemical unloading and temporary storage. Provisions are being made for delivery of chemicals by freight car as well as by truck. Three railroad spurs and one truck passageway for the delivery of chemicals will be enclosed, forming a part of the ground or first story.

On the second or operating floor there will be space for the alum dry-

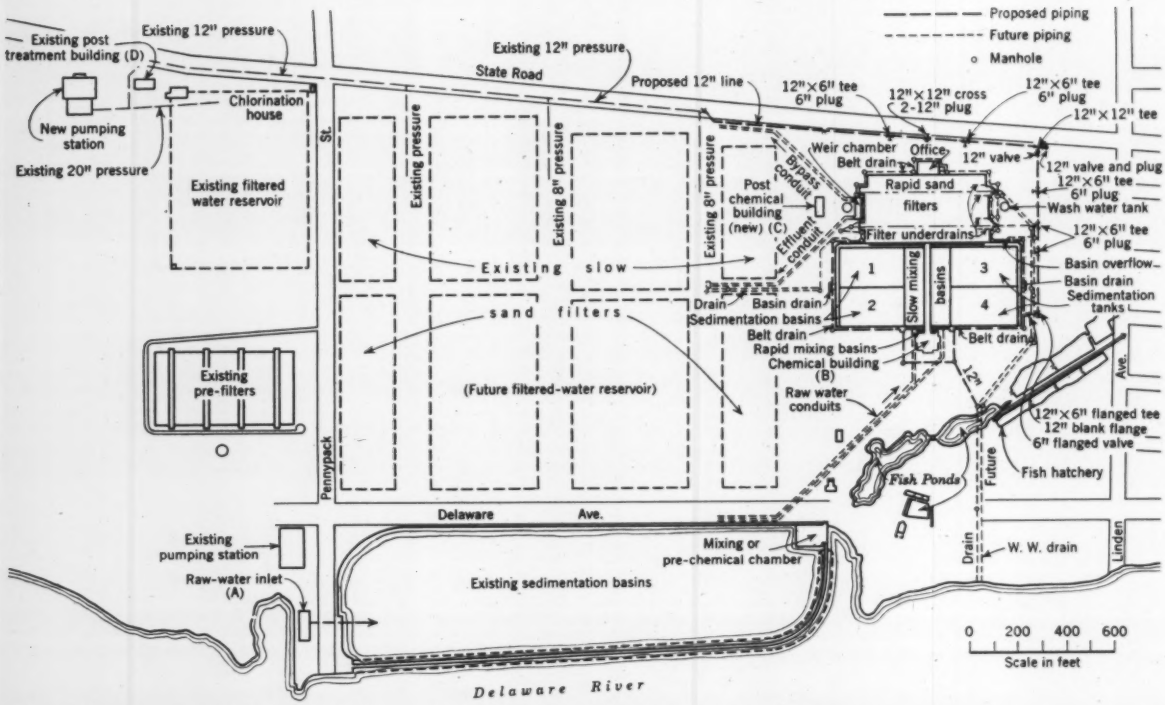
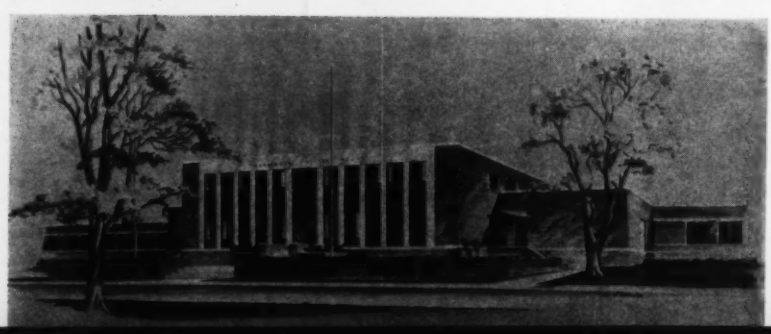


FIG. 2. New filter plant is being built adjacent to existing Torresdale plant. Slow sand filters of old plant will be converted to filtered-water reservoir, increasing filtered storage capacity to 200 million gal, or about one day's supply.

Construction progresses on center or north-south gallery of rapid sand filters. Plant has 94 filter units, each with rated capacity of 3 mgd at 2 gal per sq ft per min.

feed equipment, pebble lime slaker and feeding equipment, carbon feeding equipment, feeding equipment controls, and operators' quarters, toilets and locker-room facilities. In separate areas, chlorinators and evaporators, chlorine control equipment, and sodium chlorite solution tanks and feeding equipment will be installed.

The third floor will provide space for sodium chlorite storage, sodium chlorite mixing tanks, and liquid-alum



Two-story Office Building, when completed, will house offices and conference rooms on first floor and laboratories on second floor. Architects are Antrim & Etter.

constant-level tanks, in addition to three storage bins for powdered alum and three storage bins for pebble lime. The roof over the chlorinator and evaporator room, the chlorine control room, and the sodium chlorite solution tank and feeding room will be at this floor level. The fourth and fifth floors will house the receivers for the unloading of alum and lime, the screw conveyors for filling the various bins, and the dust collecting equipment.

Freight and passenger elevators are being provided.

Provisions are being made for carload delivery of chlorine and carbon, chlorine being stored and used directly from the cars. Two tracks with car scales are being installed for this purpose. Carbon will be dumped directly from the cars into slurry tanks below car level, where water will be added and mixing accomplished to form a slurry which will then be pumped to points of application by slurry pumping equipment. Truck delivery is being provided for powdered alum, pebble lime and sodium chlorite, although car delivery will be possible if it is found expedient. Delivery of liquid alum, when initiated, can be made by either truck or car. Facilities will permit delivery of carbon and chlorine by truck as well as by car.

Chemical storage and feeding equipment are being provided for a maximum daily water production rate of 423 million gal.

Facilities will permit the application of alum and lime in the influent channels to the rapid mixing basins and at the diffusion walls between the slow mixing and sedimentation basins. Carbon for taste and odor control can be applied in the influent channels to the rapid mixing basins, in the first trough of the collector system (about three-fourths the length of the sedimentation basins), and in the influent conduits to the rapid sand filter plant.

Chlorine application

Chlorine can be applied at the Raw-Water Inlet (A) to the presedimentation or tidal basin, in the raw-water influent conduits to the rapid mixing basins (B), and in the effluent lines from the new Post Chemical Building (C). Chlorine in liquid form will be conveyed from this location to the existing Post Treatment Building (D), where chlorine feeding equipment will in turn apply chlorine for booster dosing of effluent water from the slow sand filter area when this area has been converted into a filtered-water reservoir. (Letters indicate locations in Fig. 2.)

Chlorine dioxide for taste and odor treatment may be applied at the inlet to the presedimentation or tidal basin, in the effluent channels from the rapid mixing basins, and in the effluent conduits from the Post Treatment Building. Feeding equipment for chlorine and chlorine dioxide at the inlet to the presedimentation basin is being provided for a maximum inlet flow rate of 750 mgd.

Eight rapid mixing basins with equipment will be constructed adjacent to the main Chemical Building. Mixing time at the design rate of 282 mgd will be about 20 sec, with controls for either parallel or series operation.

Four flocculation or slow mixing basins equipped with transverse-type paddle shafts are under construction, with driving equipment installed in dry wells. Flow will be straight through from influent diffusion wall to outlet diffusion wall and will provide a detention time of 45 min at normal rate.

Also under construction are four single-story sedimentation basins, each about 300 ft × 188 ft 6 in., with an effective water depth of 18 ft 3 in. Water will enter from the outlet diffusion walls of the slow mixing basins, flow straight through to collecting troughs or channels at the ends, and thence into collector conduits which will convey the settled water to the rapid sand filters. Cleaning equipment of the centrifugal type, having a diameter of 174 ft 6 in., will automatically clean about two-thirds of the area of each basin. Detention time in the sedimentation basins will be 2½ hours at the normal daily rate of flow.

Sludge removed by the cleaning equipment will be collected in sludge chambers and thence pumped to an existing lagoon below the preliminary sedimentation basin and the raw-water pumping station.

Access wells have been provided between the east and west pairs of slow mixing basins extending from the Chemical Building to the substructure of the rapid sand filters for installation of chemical and other piping as well as a passageway.

Rapid sand filters

The rapid sand filters will include 94 single units, each having a capacity of 3 mgd at a design rate of 2 gal per sq ft per min, and a maximum rate of 4½ mgd. The filters are arranged on each side of two east-and-west galleries with a north-and-south gallery dividing them. Each two of the 92 units will have a common influent and wash-water gullet and will be controlled from a combined operating table. The two units adjacent to the wash-water pumproom will be single units. Semiautomatic operation of the filter units is provided.

Concrete influent conduits will extend from end to end of the east-and-west galleries and connect with the settled-water conduits from the sedimentation basins. Effluent conduits, constructed of concrete, are located at each side of the pipe galleries and below the floor of the filter boxes. Concrete wash-water sewers are located below the pipe gallery. Wash-water troughs are of concrete.

Filter units are being equipped with "duplex filter bottoms," 10 in. of graded gravel, and 28 in. of sand, and will have a freeboard of 31 in. Filters will have surface wash systems utilizing sweeps, three in each single filter unit, water being pumped directly from the effluent conduits. Pumping equipment will consist of three 500-gpm motor-driven units, which will permit washing of four single units at the same time. A third pump is provided as a spare. Pressures at the sweeps will be 85 psi. Relief valves in the system will prevent pressures in excess of this amount.

Filter piping will be predominantly of steel but some will be of cast iron. Generally pipes 24 in. in diameter and larger will be of steel. Valves will be of both gate and butterfly type. Valves 24 in. in diameter and larger will be of the butterfly type, and smaller valves will be of the gate type, with the exception of the valves in the wash-water piping at the filters. Half the wash-water valves at the filters will be gate valves and the other half butterfly valves.

A weir chamber is provided at the southerly end of the filters with filtered-water conduits leading to the Post Chemical Building.

The filter units will be controlled by rate-of-flow controllers regulated collectively by two float stations, one in the effluent conduits downstream from the weir chamber and the other in the filtered-water reservoir. The units can also be regulated individually, either automatically or manually, from the filter operating tables on the filter operating floor in front of the filters. Equipment at each table will permit either automatic or manual operation, and changes from one to the other as desired.

Wash water will be pumped from a common effluent conduit from all filters through the wash-water piping system into two 300,000-gal elevated steel tanks by four motor-driven centrifugal pumping units, each with a ca-

(Continued on page 106)

Illusions of leisure

MASON G. LOCKWOOD, President of ASCE

Partner, Lockwood, Andrews & Newnam, Houston, Tex.

Members of ASCE Student Chapters, young men looking forward to starting a career in engineering, as well as older men interested in Student Chapter activities, heard this address of Mason G. Lockwood, then the Society's President-elect, at the Student Chapter Conference Luncheon at the Pittsburgh Convention last October. This publication of the address comes at a time when many of those who heard it originally, as well as engineering seniors throughout the country, are about to leave academic halls and step out into full-time jobs in the business and industrial world.

When he was thirty years old, Albert Schweitzer abandoned his secular career and turned his back on assured greatness as a composer, organist, and philosopher. The next eight years he spent preparing himself for a new, far less remunerative career as a medical missionary. At thirty-eight he began life over again in a cluster of huts in the Belgian Congo.

Many consider him the greatest man in the world, and surely he is as nearly deserving of that title as anyone living. He was awarded the Nobel Peace Prize of 1952. A man who has lived more than forty years in a jungle, yet attained world-wide recognition as missionary, physician, theologian, composer, organist, philosopher, and author, surely must be incredibly dedicated as well as gifted.

Now over eighty, Dr. Schweitzer still maintains a weekly work schedule that is more than twice as long as most of ours. He "recreates" by varying his occupation. During the day and part of the night he is a minister and physician. His "free time" in the evenings is devoted to writing, correspondence, and playing Bach and American jazz on his organ.

Writing is said to be one of the most exacting of all professions. Most people who write spend most of their lives precariously. For nearly all writers must support themselves by means other than writing during most of their lives. Yet much of the world's greatest literature has been written by "part-time" professionals.

Balzac sometimes wrote all night; he was a businessman during the day. He wrote more than sixty books. T. S. Eliot, author of *The Waste Land* and *The Cocktail Party*, was in former days a banker. Herman Melville acted as a customs collector, William Faulkner breeds mules, and Thornton Wilder is a teacher. *Moby Dick, A Fable*, and *The Bridge of San Luis Rey* were all written on a part-time basis, respectively by a civil servant, a Mississippi dirt farmer, and a not-so-absent-minded professor.

Why work hard?

What is it that has driven men like these, for centuries, to sacrifice so much leisure and comfort? Why have they worked so hard?

The life story of Winston Spencer Churchill, however familiar, is so incredible that it reads at times like a Hollywood script. Probably no one else in the past two generations has seen more, done more, and been more than this truly remarkable man. He is, of course, one of the real giants of the twentieth century.

A soldier, politician, sportsman, writer, diplomat, and historian, he has truly distinguished himself in all those fields. With all that Churchill has done, he has somehow found the time to write several million words—some of them, incidentally, judged excellent enough to win a Nobel Prize. After eighty-odd years, he still works and plays as hard as his health will permit—and probably a great deal harder than most of us feel *ours* would permit.

Not everyone who works hard possesses genius, naturally, though the converse of that statement would be difficult to prove. For a very long time most Americans worked hard through necessity. For perhaps 250 years after Jamestown was settled, there was no significantly large stratum of American society that could rightly be called a "leisure class."

We have always rebelled at any idea that class lines divide us. Though definite "classes"—economic or otherwise—certainly exist in America, they never have been as traditional and accepted a part of life as in Europe. But in recent years a greater and greater proportion of the rapidly expanding middle and upper strata of our society has been becoming a "leisure class." This phenomenon is not exactly tangible, because it is more of a feeling, a mood which is becoming more and more pervasive.

This mood seems to have taken possession of large numbers of young people, especially those just out of, or not long out of college. Young engineering graduates may be less victimized by this fever than other college graduates. But the methods being used by some engineer-employers to attract young graduates certainly indicate that fringe benefits, shorter hours, and emphasis on leisure are telling inducements, and that a higher premium is being placed on the illusory thing we call security

than ever has been placed on it by any previous generation of young Americans.

I am not one who decries the high starting salaries for young engineers. I do think some serious inequities are to be found a few grades up the line from the beginning salaries. But the way to cure that is to get these grades adjusted upward, not the beginning salaries adjusted downward.

Nevertheless I definitely believe that a young engineer makes a serious mistake when he allows salary, fringe benefits, and promised security to dominate his choice. As important as these factors are to a young engineer and his family, he should in my judgment give great weight to the question of whether the job is one he is going to enjoy day after day, week after week. And especially, will the job lead eventually to whatever it is he wants?

Preoccupation with security

Frankly I find it a little hard to understand present-day youth's great preoccupation with security, and I hope no one will interpret that to mean that I am finding fault with such old and essential virtues as thrift, planning and judgment in matters of long-range welfare. But where would this country be if the youth of other generations had not been daring about some of these things?

What security could a young man offer his wife and prospective family as they climbed into a covered wagon and headed into the relatively unknown West? What security could be guaranteed by the contemporaries of your fathers when a man of your age persuaded someone to loan him enough money to start a shaky business in a shaky community during a shaky time? And remember that many such enterprises began without benefit of such risk removers as are now commonplace—insurance, fire protection, flood control, public liability and property damage coverages—and in the face of lawlessness and a host of other hazards to which we are not exposed.

An inexorable fact of nature is that man progressively grows more conservative with age. If he is not daring in youth, if he is not then willing to take reasonable risks, the chances are he never can.

Incentive needed

It may be that circumstances, rather than men, have changed. But it saddens me a little to see people, especially young people, so satiated with the by-products of prosperity that the incentive of material possessions is lessening. Money has seldom made people happy, but it has always been a pretty good incentive for production. A man with ten million dollars is no happier than a man with nine million. But not having much money frequently has been a wholesome influence in men's lives.

Our high standard of living, together with our modern credit techniques, makes it possible for young families to have many of the material satisfactions of life at a much earlier age than ever before. I do not deplore that per se, of course, but it does seem to be removing one of the dominant incentives for hard work and heightening the clamor for more leisure.

We can never have too much leisure time if we use this leisure for good purposes. It appears to me, though, that too many young people are quite content to devote nearly all their leisure to comforts, physical satisfactions, and an aimless waste of time. Inevitably, as has been demonstrated over and over, this can lead only to stultification and utter boredom. In such instances unhappiness follows, and the potential of one of God's lives is lost.

Satisfaction through accomplishment

It is trite indeed to say that busy people are useful people or happy people. But no one can deny this truth. Sometimes we confuse a frantic person with a busy person, and there is a great difference. But on the whole, nothing seems to satisfy man's inner longings so much as the satisfactory accomplishments derived from useful activity.

Because we have so much leisure time after our forty-hour work week, it is vitally important, I believe, that we do not use it carelessly. True, some of us engage in active recreation: some of us play golf, or hunt or fish, or even work in the yard or in a shop. But I am afraid many of us spend most of our free time "being entertained," or trying to be. We spend it in front of television, or in movies, or simply in idle conversation. And still we are not satisfied. We are too much preoccupied with obsessive seeking after diversion, novelty, or gratification.

Man, as everyone knows, did not discover that he possessed a soul until he had a reasonably full stomach. Only then was he sufficiently free from the mundane necessity of scratching out a living to permit himself to turn some of his thoughts and efforts toward what we loosely call "culture."

Our stomachs, like the Romans', are too full. Plenty has made many of us fat, lazy, complacent, mentally impenetrable, bored, blasé, and sophisticated.

Our heritage of leisure

As I get older I almost mourn the decreased leisure which I have already experienced personally. Each of us would do well to recognize our increased and increasing leisure for what it is—a blessing, a boon and a heritage from billions of people through thousands of years yearning to make themselves and their loved ones just a little more comfortable during their own brief stay on earth. Thus it deserves to be accepted with a little more sense of responsibility, if not, indeed, with more reverence.

I don't mean to imply, of course, that no one in the so-called "middle" and "upper middle" classes works hard. Many work too hard, as is well known. The American Management Association and the editors of *Fortune* agree that the work week of the average executive, for example, is at least 48 hours long. I would have guessed it to be even longer.

And finally, now that you are soon to become engineers in the practicing sense, and at a time when there is, as you so well know, a critical shortage of engineers, you more than any other body of young men need to get the most out of your leisure time. You need to do this for your country as well as for yourself and for your family.

All sorts of devices are being employed and considered by industry in its efforts to stretch the supply of engineers and scientists. Women college graduates, for example, are being used to serve as engineering assistants, taking over from the engineers much of the mathematical and other semi-technical work connected with design and development engineering. In many instances clerical aids of one sort or another are being supplied to engineers so that they will not have to spend so much time writing papers and reports that these aids might handle.

You would do well to start training yourself now to save all the time you can during your working hours and use all the time you can during your leisure hours for improving yourself. If, for example, during your leisure hours you could improve your facility for writing, improve your speed, learn to dictate, that would prove most helpful and would be noticed rather quickly by your superiors.

You young men are no more guilty of abusing our "leisure heritage" than any of the rest of us. But, being young men, your heritage is a bit richer. We shouldn't be satisfied just to inherit this privilege—we should try to earn it.

NEW COLOMBIAN RAILROAD

will connect capital with Atlantic Ocean

ELMER B. ISAAK, M. ASCE

Vice President, Madigan-Hyland South American Corporation, New York, N. Y.

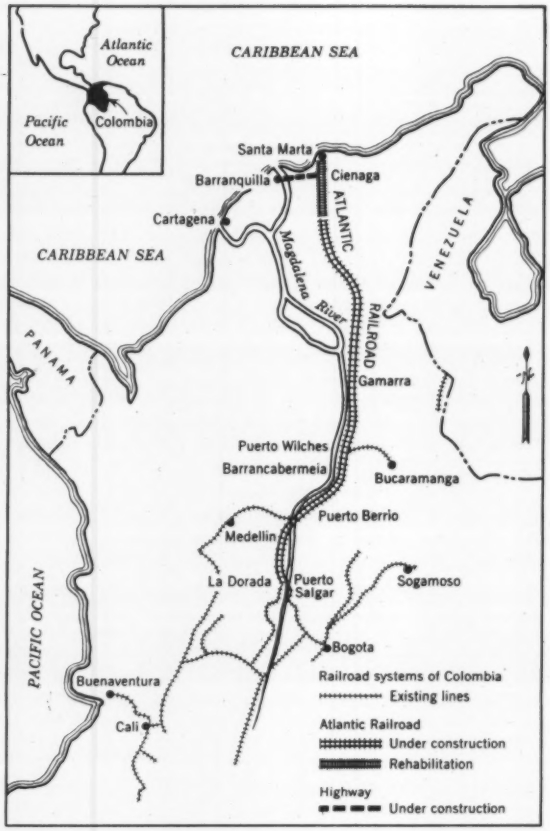


FIG. 1. Atlantic Railroad, now under construction, will supply vital link between Bogota, capital city of Colombia, and Atlantic Ocean.

Transcontinental railroad building is generally viewed as a part of the pioneering past, but in Colombia, South America, a 400-mile link is being pushed which will result in the first rail connection between the Atlantic and Pacific oceans in the northern half of the continent. Tying in with the existing Pacific Railroad in the western part of Colombia, the new "Atlantic Railroad" will unify the entire rail network of the country and provide a direct route from the interior to the Atlantic coast. See Fig. 1.

A nation physically divided by three towering ranges of the Andes, Colombia has long suffered from an acute lack of transportation. Present shipping routes between Caribbean ports and Bogota, the capital and largest city, depend principally on the unpredictable Magdalena River for a distance of 475 miles to Puerto Salgar. Delays of several weeks are not uncommon when the river level is low. At Salgar the cargo must be transferred either to rail or truck for the mountain haul up to the 8,600-ft elevation of the capital.

The new line will provide an uninterrupted rail haul of 585 miles from the port of Santa Marta to Bogota. This route will utilize 59 miles of existing railroad running inland from the port, as well as 125 miles of present line between Puerto Salgar and Bogota.

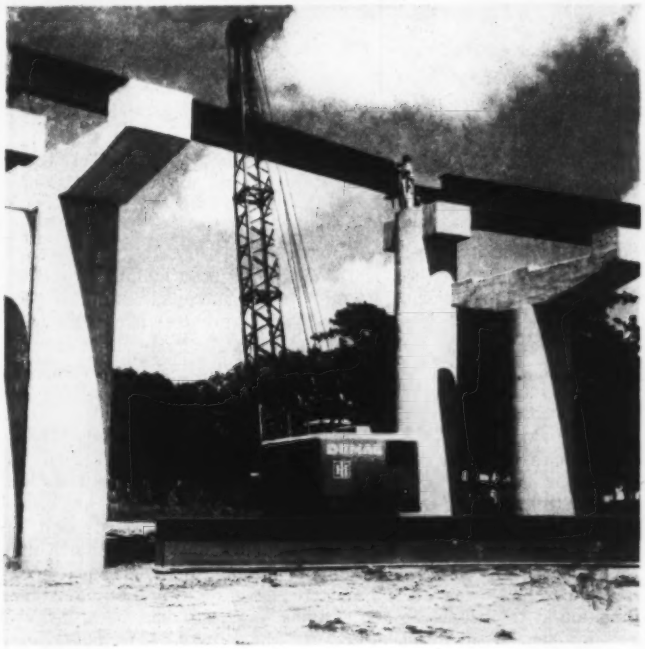
Following the valley of the Magdalena River for most of its route, the new Atlantic Railroad will also make possible railroad access from the interior to the Pacific by connecting with existing lines passing through Medellin and Cali, two of the most important industrial centers of the country. Direct connection will also be made with a branch line, heretofore isolated, running between the Magdalena River at Puerto Wilches and Bucaramanga, commercial and industrial center of an important coffee growing region near the border of Venezuela.

Integrally related to the through rail operation will be a new 36-mile highway now under construction to connect the port of Barranquilla with the railroad. Since Barranquilla is the most important of Colombia's Caribbean seaports, the railroad plans to run a fleet of tractor-trailer trucks for the transfer of freight to a terminal at Cienaga, a point on the existing rail line about 20 miles south of Santa Marta. This highway connection will also involve the operation of a ferry crossing of the Magdalena River at Barranquilla.

The real importance of this project to the economy of the nation can readily be seen. It will provide a direct connection between the interior and the Atlantic coast. It will unify Colombia's disconnected railroad system, tying all significant parts together and providing direct transportation between the nation's leading population centers, heretofore not directly accessible to each other except by air or tortuous mountain roads. It will facilitate the use of the Atlantic ports, gateways for trade with the eastern United States and Europe, and eliminate the present costly practice of shipping cargo through the Panama Canal to the Pacific port of Buenaventura, an expedient frequently used to avoid the uncertainties of the Magdalena River.

Dollar funds for the project are being advanced by the International Bank for Reconstruction and Development, and local funds are furnished by the Colombian Government. The national

One of two largest bridges on Colombia's Atlantic Railroad crosses Magdalena River at Puerto Salgar, carrying one rail line and one highway lane. In view of approach structures, note that supports for highway lane appear in front of high, narrow rail line.



Ministry of Public Works is charged with responsibility for the construction, but when completed the line will be operated as part of the National Railroads of Colombia, a semi-autonomous enterprise.

The World Bank funds come from two separate loans totaling $40,900,000. Originally the project extended from the interior to a river terminal called Gamarra, and it was intended to transfer the cargo to and from river boats at this point, since the Magdalena is fully navigable from there on all year round. The scope of the project was reopened by the government after construction started, and economic studies by Madigan-Hyland South American Corporation of New York, consulting engineers to the Ministry of Public Works, showed that better results could be achieved by extending the project to the Caribbean coast. The World Bank subsequently granted a second loan, and the extension of the line to Santa Marta was assured.

Under the agreements with the International Bank, the Colombian Government will furnish all local currency required for the project. This will constitute something more than half the total cost, so that the value of the entire project will be between 90 and 100 million U. S. dollars.

From the outset of the construction early in 1953, emphasis was placed on the development of local contractors to handle the earthmoving, drainage, and virtually all other phases of the work except bridge construction. Since this was contrary to the previous practice on large projects in the country, which had relied heavily on foreign contractors, new organizations had to be formed and encouraged, with the guidance of the consulting engineers to whom the Ministry and the World Bank looked for over-all supervision. Special purchasing arrangements were set up to provide the contracting firms with equipment, and the construction contracts were originally negotiated on a cost-plus-a-fee basis. After an extended breaking-in period of nearly two years, all contracts were converted to unit prices.

Line location was handled almost entirely by Colombia engineers and surveyors, under the guidance of the consultants. Aerial photography was used to prepare topographical maps by Lockwood, Kessler and Bartlett, and from these maps the preliminary line was selected. On the original stretch, more accurate topography for the final location was secured by ground survey. On the extension, ground-controlled photogrammetry was used to determine the final line, with only minor modifications and staking out performed by ground survey crews.

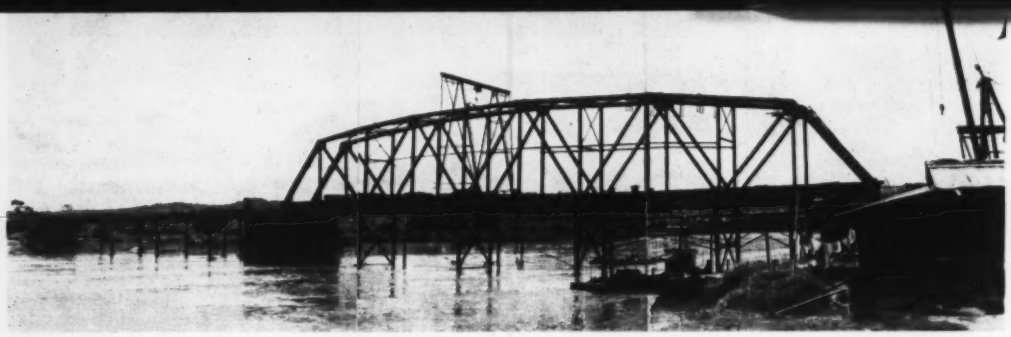
Since the Magdalena River Valley traversed by the Atlantic Railroad consists principally of flat and rolling terrain, high standards for line and grade were established by the Ministry of Public Works. Maximum grade is one-half of one percent and minimum radius of curvature is 1,650 ft.

In keeping with all other railroad lines in Columbia, there will be a single track and the gage is 3 ft. Rail weight is 75 lb per yd. These standards may appear surprising to some United States engineers, but this type of track is ample to carry the anticipated volume of traffic and will result in substantial savings in construction cost.

Total earthwork for the project is estimated at 34,000,000 cu yd, of which approximately 70 percent had been moved through February 1957. Although there is no mountain terrain, cuts up to 100 ft have been encountered. In some of the larger cuts clayey materials have caused considerable difficulty with slides, and special measures are necessary to correct the situation. Where the clay underlies sandy material it has been necessary to flatten the slopes to approximately 1 vertical on 2 horizontal because the weight of the sandy outcrops causes undermining of the softer strata when moisture is present.

On the other hand, where sandy material lies below a layer of clay, a steeper slope can be used at the lower levels, thereby saving considerable yardage. In many locations it has been found that the steeper slopes, up to about 1 vertical on ½ horizontal, frequently stand up better than flatter slopes where the material is such that slipping does not occur. With the steeper slope, there is less chance for erosion and less disturbance of the original soil conditions. In a number of cuts subsurface drains or intercepting ditches are being constructed. Another useful measure in doubtful cut locations is the widening of the base beyond the standard 7 m (23 ft).

The varied soil conditions found over the length of the project point up the importance of analyses from the viewpoint of soils engineering. A



fully equipped soils laboratory has been established at a central point on the work, and an attempt is being made to anticipate subsurface conditions as much as possible. Two extensive reports have been prepared by special soils consultants—Goodkind and O'Dea of Hamden, Conn., and Rockwell Smith, Roadway Research Engineer, Association of Amer. Railroads.

The most difficult problems to overcome in creating the roadbed have been in areas of several very extensive swamps, with depths ranging up to 74 ft. Because of the limitations of available equipment and time, the principal approach has been simply to pile on the fill in lifts, relying on the repeated passage of heavy equipment to secure compaction. Berms have been recommended by the soils engineer in a number of swamp locations. Some of these swampy areas are still giving trouble, and studies are now going on to determine whether sand drains would be the most economical solution in the long run.

Numerous rivers and streams flowing into the Magdalena River from both sides have made necessary the construction of over 80 bridges. The two largest of these cross the Magdalena, one between Puerto Salgar and La Dorada to connect the Atlantic Railroad with the line to Bogota, and the other at Puerto Berrio to bring the line from the western bank to the eastern bank of the river. Two other bridges cross major navigable streams, the Nare and Sogamoso Rivers.

The four major bridges are under construction by two German contractors, Hein Lehmann & Co. and GHH MAN. All four bridges were originally designed with 250-ft steel through trusses, but on request of the navigation interests, the government decided to substitute one 500-ft span for two 250-ft spans for the Puerto Berrio Bridge.

The principal problems involved in constructing the Magdalena River bridges arise from the swiftness of the current and the changes that can occur in river conditions within a very short space of time. Steel sheetpile cofferdams are being used at all the river piers, and these require protection against erosion—secured by placing riprap around the bases. During the period of construction at the Sogamoso River, changes in the river level amounting to 6 ft have occurred within 24 hours. The north span of this bridge has been constructed on the bank, which is at such a height that it is above the tops of the piers. This span will be pushed into position on the piers with the aid of falsework supported on barges. The south span will be erected in place by using falsework pile bents erected in the river.

The two Magdalena River crossings will carry a single highway lane in addition to the railroad track. This arrangement resulted in an interesting problem in design, since the lighter loading of the highway lane required a lighter truss on its side than on the railroad side. For the sake of appearance and symmetry, the dimensions of the two trusses must be the same, but the weights of the members are distinctly different.

For all the other crossings, a standard design has been adopted based on a 50-ft steel-beam span resting on concrete-filled 18-in. steel pile bents with concrete caps. As many units as necessary are used at each crossing, the number varying from 2 to 15. All these bridges are under contract to a single French firm, Enterprises Metropolitaines et Coloniales. Eleven of these crossings, located between La Dorada and the Nare River, are virtually completed. A second group of eleven is under way to the north and south of Barrancabermeja, and the remainder have recently been awarded.

Laying of track has been delayed because the bridges were not ready, but rails and ties have been placed for a stretch of 24 miles south from Puerto Berrio, where no bridges occur. Track laying has also been started northward from La Dorada, and will progress as groups of bridges are completed.

More critical than track laying at the present time is the production of adequate quantities of ballast. Two contracts were let early this year for the stockpiling of ballast at two large gravel deposits, but numerous difficulties, including the inexperience of the contractors, have made the results disappointing so far. A plan is now being formulated to increase the production of ballast by procuring additional screening and crushing equipment and securing personnel capable of operating it.

Ties are of untreated native hardwood, felled and hewn largely by hand methods. Contracts are made with various independent producers, who organize timber gangs in local areas. For many months a crisis existed in the procurement of ties, but positive action on the part of the National Railroads, which are handling this phase of the work, has finally produced results. Ties are now coming in at the rate of about 40,000 per month, and it is hoped that the

In total length of about 400 miles of new railroad construction, some difficult soil conditions have been encountered, among them wet cuts, one of which is pictured. Although there is no mountain terrain, cuts range up to 100 ft, and total excavation is about 34 million cu yd.

More than eighty bridges are required on new rail line. Standard units have been designed for all of these by Madigan-Hyland. Four largest bridges include total of ten 250-ft steel through trusses on concrete piers (similar to that shown in composite view at far left) and one 500-ft span. Smaller structures, exemplified by crossing at left, are made up of 50-ft steel beams on pile bents. Piles are 18-in. steel pipe, filled and capped with concrete.

target of 60,000 to 70,000 ties monthly will soon be reached.

Contracts for the 75-lb rails were placed after international competitive bidding, with 17,500 metric tons coming from the United States and 32,500 metric tons from Belgium and France.

In the four years that have passed since construction of the Atlantic Railroad began, the engineers have learned to cope with a good many situations having very little to do with engineering. To satisfy the World Bank on the merits of the loans, it was necessary for the consultants to play a leading role in revamping the entire organizational structure of the National Railroads, which until two years ago were operated as a directly controlled government enterprise. The present setup is patterned somewhat on that of the "authorities" now utilized so widely in the United States to operate revenue-producing facilities. The responsibility rests with a board of directors nominated for the most part by representative business, industrial, banking, and agricultural organizations.

With both the Ministry of Public Works and the National Railroads in the picture, with the World Bank furnishing the dollars and making certain policy requirements, and with the National Government supplying the pesos, the situation at times was something less than clear, particularly as regards funds, accounting, and purchasing arrangements. To establish the responsibilities of the various agencies, an administrative plan was drafted by the consultants, and after considerable discussion and revision by the parties concerned, was adopted and is operating successfully.

The attempt to develop Colombian contracting organizations has had gratifying results in many respects, but has not been without its rough spots. Most of the contractors have shown initiative and intelligence in organizing the work, and some have produced outstanding results in moving dirt. Their biggest failing has been insufficient attention to equipment maintenance, which frequently causes the loss of half the available working hours in a month due to breakdowns.

The three contractors who originally started the job, including one American firm, dropped out after completing their original contracts, but they have been replaced by others who have carried on. Because there are no large organizations with their own equipment in Colombia, the line construction is now divided among ten different contracting organizations.

Another pioneering phase of the project was the establishment of the role of the supervising engineers as technical representatives of the owner. Construction work in South America has traditionally been organized on the European system, under which the contractor is also the engineer. The government or owner exercises control over the work through a so-called "interventor," who is generally an administrator or overseer but in no sense a consulting or supervising engineer. The North American concept of separating engineering from contracting was therefore a foreign idea, but it has gradually received greater and greater acceptance and understanding from the Colombian officials in charge.

With the earthwork phase of the project nearing its final stages and the bridges well under way, concentrated attention is now being given to those many phases of the work necessary to produce an operating railroad. Procurement of track materials occupies the center of attention at the moment, so that track laying can proceed without interruption as soon as substantial stretches of the roadbed are ready.

Now in the active planning stage are operating facilities such as stations, yards, freight houses, fueling stations for the diesel locomotives to be used, and other auxiliary facilities. A major project still to be undertaken is the rehabilitation of the existing 59-mile rail line south of Santa Marta, which must be brought up to Atlantic Railroad standards.

Major improvement of the mountain line from Puerto Salgar to Bogota must be left to the future, but some of the worst spots will be corrected and passing tracks will be lengthened. It is contemplated that the trains of 50 to 60 cars which will travel over the Atlantic Railroad will be broken into five or six parts for the last leg of the haul, which in some places has grades up to 4 percent.

The Atlantic Railroad will not be fully completed for at least two years, but the benefits will not have to await its final completion. The stretch from Puerto Salgar to Puerto Berrio, including the Magdalena River bridge at La Dorada, should be ready for use some time in 1957. This will make possible the first through connection between Colombia's two largest cities, Bogota and Medellin. This connection alone will be of enormous significance, and every effort is being made to push the opening of this vital link.

A second useful part will be that between Barrancabermeja, Colombia's oil center, and the existing railroad from Puerto Wilches to Bucaramanga. A worthwhile traffic volume on this route is assured, and therefore the five bridges in this section are being given priority.

The real opening up of the vast area that is Colombia will only come, however, when the golden spike is driven to signify the final completion of the Atlantic Railroad. On that day the route to a nation's heart will at last be opened to the world. Four hundred and twenty years ago an adventurous group of 800 Spaniards set out along this route, and after four tortured months a ragged band of 174 survivors arrived at the Sabana de Santa Fe, site of modern Bogota. Today the trip by river and rail can be made in eight days if all goes well, but it may require a month or more when navigation delays occur. Tomorrow the Atlantic Railroad will carry swift diesel passenger cars between the capital and the sea in 24 hours, and will offer cargo service in 48 hours.

II. Sludge burning, gas utilization, and construction

Miami high-rate

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In Part I of this two-part article, the authors outlined the elements of Miami's new 25-million-dollar sewerage system and its high-rate activated sludge treatment plant on Virginia Key, connected with the city by a 72-in. pipeline 2¾ miles long under Biscayne Bay. In this second part they tell how the sludge is concentrated, digested, washed, dried and burned; how digester gas is used to make electric power for plant operation; how plant and ocean outfall were built.

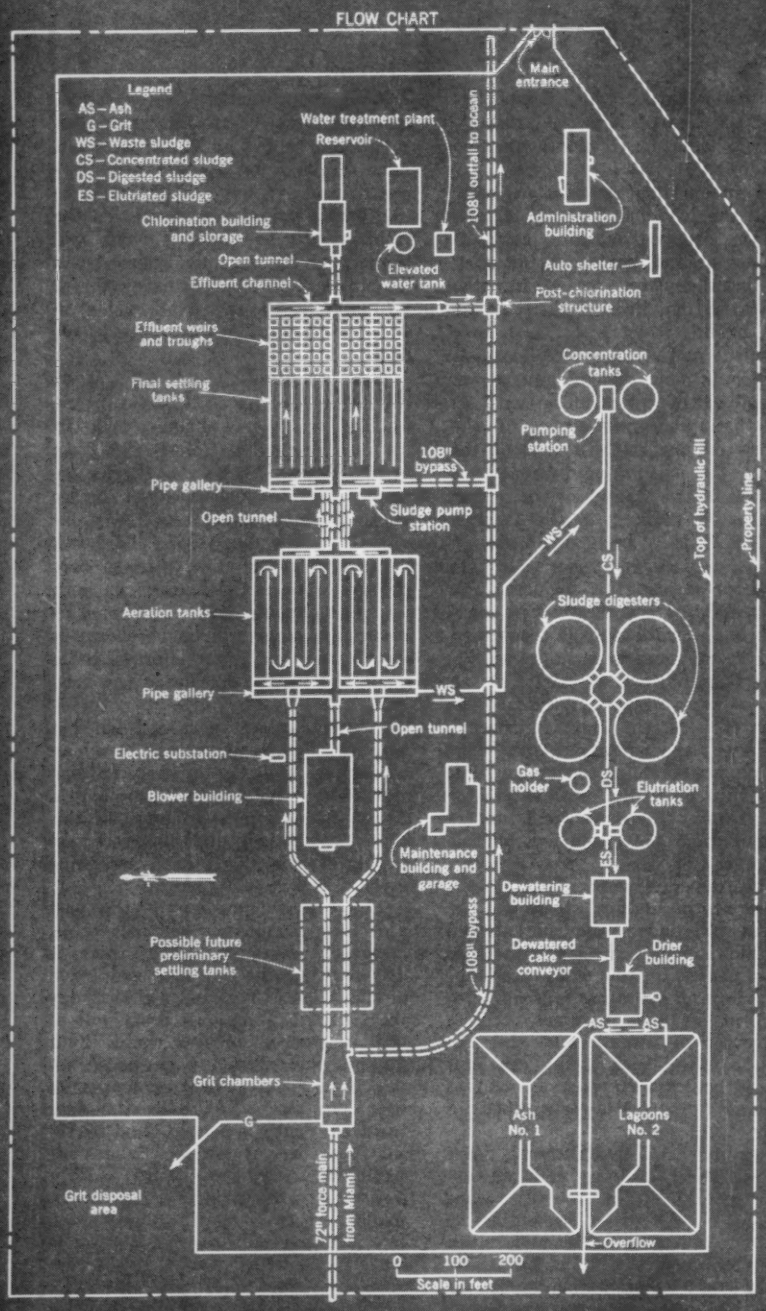
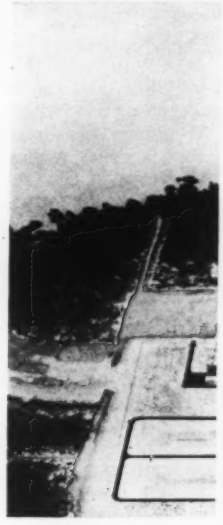


FIG. 1. Flow diagram shows layout and operation procedures for Miami Sewage Treatment Plant.



activated sludge plant in operation

Waste sludge flows by gravity from the distribution box at the aeration tanks to one of two circular concentration tanks operating in parallel. It is estimated that the solids content of the waste sludge entering the concentration tanks will be approximately 0.3 percent, and that the solids content of the sludge after concentration will be 5 percent. The two circular concentration tanks provide 100 sq ft of surface area per million gallons of plant capacity. The overflow rate at the maximum wasting rate anticipated, namely 8 percent, will be 790 gal per sq ft per day.

A scum removal device is provided on each tank to remove any scum or floating solids. Scum is discharged to outside manholes in which telescoping valves are installed to regulate the rate of sludge removal. The combined sludge and scum is pumped to the sludge digestion tanks by two plunger pumps in the pumping station of the sludge concentration tanks. The pumps will be controlled either manually or automatically by high- and low-level electrodes in the outside manholes.

In this pumping station are also installed three centrifugal pumps which move sewage from the plumbing systems of all the plant buildings, overflow from the concentration tanks, overflow from the elutriation tanks, and supernatant from the digestion tanks. The sewage and overflows thus pumped are discharged into the distribution box at the aeration tanks for return to the unaerated sewage. See the flow chart, **Fig. 1.**

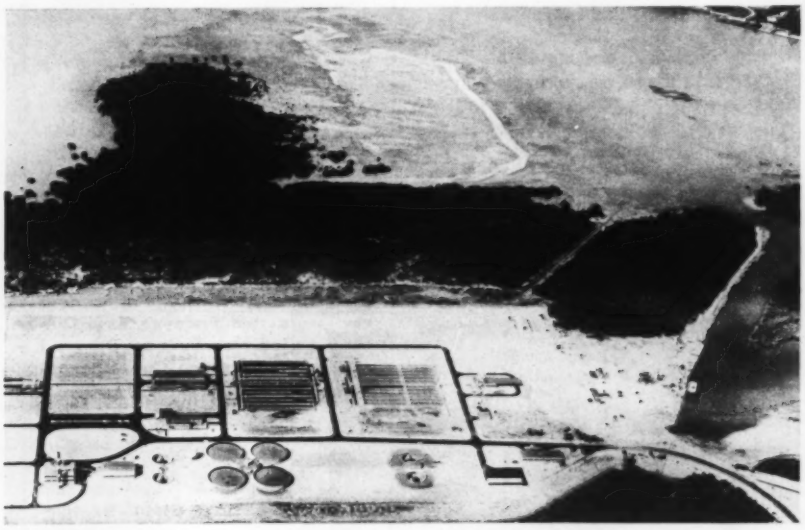
Sludge digestion tanks, to which the concentrated sludge is pumped, are four in number. They have shallow cone bottoms, each tank being 105 ft in diameter with a side-water depth of 25 ft 10½ in. and a cone depth of 3.0 ft. These tanks have a capacity of 3.3 cfc (cu ft per capita), or 20.3 cu ft per lb of dry raw solids, a capacity that is ample for this treatment process.

Although all four of these tanks are equipped with floating covers and have similar piping, it is intended that two of them be used as primary digestion tanks and two as secondary digestion tanks. Digested sludge will be transferred from the primary to the secondary tanks for storage before transfer to the elutriation tanks. Provisions are made in each tank to discharge incoming sludge to either of two points, to withdraw supernatant from four levels, to withdraw sludge from the bottom of the cone, and to recirculate the tank contents through a heat exchanger. Four screw-feed centrifugal pumps, each with a capacity of 300 gpm, transfer the sludge between the various tanks and pump it to the elutriation tanks.

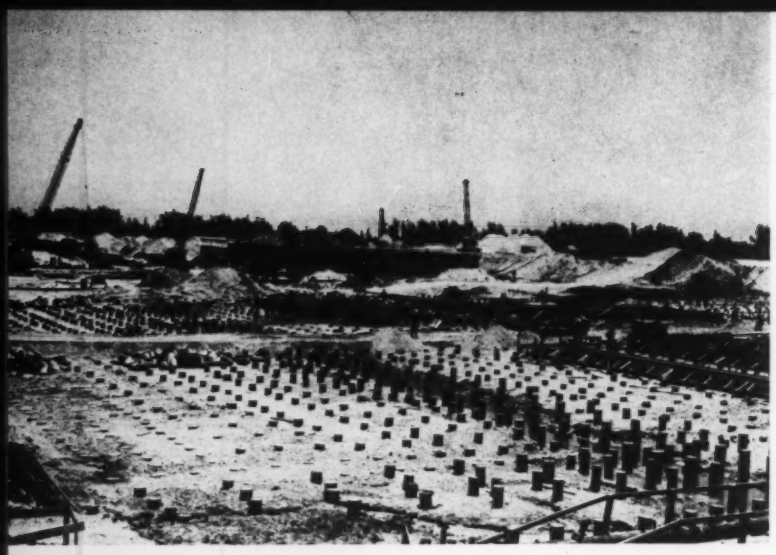
The sludge will be maintained at a temperature of 90 deg F by means of two external heat exchangers of double-tube type, each rated at a heat transfer rate of 970,000 Btu per hr. Supernatant is recirculated through each heat exchanger by a 350-gpm pump. The hot water is jacket cooling water from the engines in the blower building and is pumped to the digestion-tank control building by two pumps each rated at 140 gpm.

The control building is furnished with a combustible gas-alarm system which will automatically sound a warning if the concentration of methane in the building exceeds 20 to 30 percent of the lower explosive limit of an air-methane mixture.

Gas produced in the digestion process is used as fuel for the gas and dual-fuel engines in the blower building. It is anticipated that gas production will approximate 9 cu ft per lb of volatile solids added after normal operation is established. Assuming

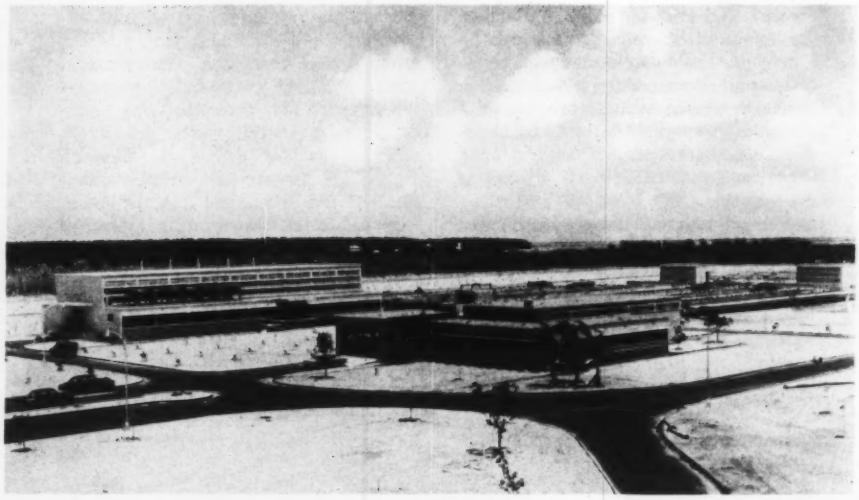


High-rate sewage treatment plant at north end of Virginia Key is designed to handle 47 mgd from Miami, Fla. This 9-million-dollar plant went into operation in September 1956. Sewage enters at left through pipeline 2¾ miles long under Biscayne Bay and effluent is discharged through ocean outfall leading from plant at right.



Nearly a million cubic yards of sand dredged from Biscayne Bay were needed to fill 65-acre area occupied by plant and access roads, formerly a mangrove swamp. Plant structures rest on piles.

Miami's Sewage Treatment Plant was built by Paul Smith Construction Co. of Savannah, Ga.



Ocean outfall of 90-in. concrete pipe extends from plant toward center foreground and ends about a mile from shore in 20 ft of water. Miami is at far right across Biscayne Bay. Outfall was built by Diamond Construction Co. of Savannah, Ga., for $1,677,461.

that the volatile-solids content of the raw solids is 70 percent, then the production will be 12.85 cu ft per lb of raw solids added, or 290,000 cu ft of gas daily.

Gas is maintained under a pressure of 5 in. of water by the floating covers. Each digestion tank is provided with a separate meter to measure the gas produced in it. Two centrifugal boosters raise the gas pressure to 30 in. for use in the engines. Excess gas beyond the requirements of the engines is compressed by two positive-displacement compressors to 40 psig and stored in a gas holder of 32-ft diameter having a volume of 17,150 cu ft. If gas production is less than required, gas will be returned to the system from the gas holder through pressure-reducing valves. Excess gas beyond what can be used or stored will be wasted through two waste-gas burners.

Sludge elutriation facilities and processes are as follows. Under normal operating procedure, digested sludge will be washed with plant effluent before dewatering on the vacuum filters. The procedure will be to draw sludge from the digestion tanks into a sludge storage tank located in the basement of the dewatering building. The rate of withdrawal into the sludge storage tank will be controlled by a hydraulically operated plug valve and timing device. Sludge will be pumped continuously from this tank into the first-stage mixing tank, where it will be mixed with overflow from the second-stage elutriation settling tank. This pumping will be done by a single-piston, variable-speed plunger pump, the capacity of which can be varied between 60 and 175 gpm. The mixture will flow to the first-stage elutriation settling tank, in which the partially washed sludge will be allowed to settle. The overflow from this tank will be discharged to the sewer leading to the overflow sump at the pumping station of the sludge concentration tanks.

The sludge will next be pumped by a similar pump to the second-stage mixing tank, where it will be mixed with fresh final plant effluent. This mixture will then flow to the second-stage elutriation settling tank, where the completely washed sludge will be allowed to settle. The overflow from this tank will flow to the first-stage mixing tank. The sludge will be pumped to the sludge elevators in the dewatering building by a third similar pump.

Piping has also been provided to operate the elutriation process as two parallel single-stage operations or to wash the sludge after primary digestion, returning the washed sludge to the secondary digestion tanks for compaction and storage, and rewashing the sludge from the secondary digestion tanks before dewatering. It is anticipated that 4.5 gal of final plant effluent will be used to wash each gallon of digested sludge.

Sludge dewatering follows elutriation and is carried out on four coiled-spring vacuum filters 10 ft in diameter and 10 ft long. Each vacuum filter is provided with its own sludge conditioning tank and sludge elevator. Sludge from the second elutriation settling tank will be pumped to the sludge elevators, which will elevate it to the sludge conditioning tanks. In these tanks, a conditioning chemical will be added to facilitate filtration—either a ferric chloride or a ferric sulfate solution. The conditioning tanks have a capacity of 200 gal and provide a detention period of about 3 min for a sludge with 5-percent solids. It is anticipated that about 5 percent of ferric chloride and no lime must be added to a sludge that has been elutriated at a 4.5 to 1 ratio to produce a filterable sludge that will filter at a rate of about 4 psf per hour. However, the filters have been designed on the basis of 2.5 psf per hour, thus providing a factor of safety.

Each filter has 300 sq ft of filter area. On the basis of a 2.5-lb loading, the average operating time at the end of the design period, using three filters, will be 17.6 hours for a five-day week. Two vacuum pumps, each with a capacity of about 1,630 cfm, provide a vacuum of 12 to 15 in. of mercury against a shutoff vacuum head. Filtrate will flow to four individual filtrate receivers, each with a capacity of approximately 325 gal, from which it will be pumped by four filtrate pumps, each rated at 75 gpm. Filtrate will be returned to the elutriation tanks.

The sludge cake will be discharged from the filters onto belt conveyors, one 18-in. troughed belt serving two filters. These two belts will discharge to a 24-in. cross-belt conveyor, which will in turn discharge to the main 24-in. conveyor leading to the sludge drier building.

Conditioning chemicals are stored in a room on the first floor of the dewatering building and will be dropped through a wooden chute into a 350-gal mixing tank equipped with air agitation. The mixing-tank contents will be transferred into a 1,500-gal storage tank, from which it will be pumped by two 10-gpm pumps to an overhead constant-head tank. The solution will then be conducted to feeders located at each sludge-conditioning tank. All equipment and piping in contact with conditioning chemicals are lined with hard rubber or its equivalent.

Before the 24-in. belt conveyor enters the sludge drier building, provision is made to permit the discharge of dewatered sludge cake from this conveyor either to trucks or to a stockpile.

Two sludge incinerators of the "flash-drier" type are provided, each with an evaporative capacity of 6,500 lb of water per hour when drying sludge to produce fertilizer. If it is assumed that the dewatered sludge contains 75 percent water, and that the dried sludge contains 8 percent water, then each furnace will handle 10,500 lb of wet cake per hour when producing fertilizer, and 9,300 lb of cake per hour when burning to ash. This is equivalent to 3,150 lb and 2,800 lb of dry solids per hour respectively. Three filters could produce this cake at a loading of 3.5 lb and 3.1 psf per hour, respectively, or two filters could produce it when operating at 5.2 lb and 4.7 psf per hour.

At this time the incinerators are equipped to burn sludge to ash only. However, fertilizer can be produced if and when coolers, pelletizing equipment, grinding equipment, conveyor systems, and storage bins are installed.

Under normal operation, dewatered sludge will be diverted onto one of two slow-moving cross-belts inside the sludge drier building, with one cross-belt feeding each furnace. The sludge will be weighed and discharged into a mixer, where it will be mixed with a portion of dried sludge. The mixture will be discharged into a duct into which hot furnace gases will also be discharged, and will next pass through a cage mill in which the water will be removed. The dry sludge and moisture-laden gases will next pass through a cyclone separator, the gases being drawn off through an overhead duct by means of a vapor fan. The dry sludge will be withdrawn from the bottom of the cyclone separator and will be divided, part returning to the mixer and part being carried by screw conveyors to the furnace to serve as fuel for the combustion process. The vapor-laden gases will pass through a deodorizing unit in the furnace, which will also act as a combustion-air preheater, and will then be discharged, through an induced-draft fan, into the stack, which is 125 ft high.

Oil will be used as auxiliary fuel for the furnaces because all the gas generated in the sludge digestion tanks is required for the blower engines.

Ash will be discharged from the

furnace into a wet sump from which it will be pumped periodically to ash lagoons. The clear overflow from the ash lagoons will flow into the mangrove swamp west of the plant site.

Metering is provided for throughout the plant. The various metering systems are pneumatically operated and include transmitters, summation units, log units, ratio units, and receivers which record, indicate, and totalize the data secured. Receivers are mounted at various points throughout the plant to facilitate operation.

Fresh city water is supplied to the plant for sanitary needs and for makeup water in air conditioning units and for engine cooling. This water comes from a 12-in. main in the Rickenbacker Causeway which serves Key Biscayne. Flow in this main is controlled by altitude valves on the mainland which close when heavy use of water on Key Biscayne causes the pressure in the pipe to drop below 50 psig. Consequently the supply of water to Virginia Key is uncertain. Moreover it is possible that the pipe in the causeway might be damaged by a hurricane. For these reasons storage for 100,000 gal of fresh water has been provided at the treatment plant in an elevated tank.

Four other water systems have been provided—low-pressure flushing water, chlorine-injector water, high-pressure flushing water, and extra-high-pressure flushing water.

The low-pressure flushing water and chlorine injector water systems use chlorinated final plant effluent, which is strained through a 16-in. manually cleaned strainer with ⅜-in. openings. Chlorine solution can be added to the pump suction for slime control.

Four low-pressure pumps can furnish low-pressure flushing water to the ash-handling system in the sludge-drier building, to the elutriation tanks, and to the foam-control system on the aeration tanks. A self-cleaning strainer with 1/16-in. openings is used on the foam-control system. Pumps are manually controlled. Two pumps furnish water to the chlorinator injectors.

The high-pressure and extra-high-pressure flushing water systems require large quantities of water daily for cleaning, maintenance, and operation of the plant. Equipment uses include vacuum filter sprays, gas compressor cooling, diffuser-tube washing, pump seals, and irrigation of the grounds. To satisfy these requirements, a part of the plant effluent can receive additional treatment to improve its quality for use as high-pressure flushing water.

Plant effluent withdrawn from the plant outfall will pass through a basket-type strainer where solids ⅜ in. and larger are removed. After straining, the effluent can be pumped to an upward-flow settling tank by low-lift pumps. Provision is made in the pump suction piping for prechlorination before chemical treatment and filtration.

Lime, alum, calgon, and activated silicate, as required, can be applied proportionally at the settling tank by positive-displacement pumps. The sludge from the settling tank will be discharged into the plant outfall. The effluent from the settling tank will flow by gravity through open-tub rapid sand filters where the flocculent traces of the coagulants will be removed. These filters will be periodically backwashed with filtered water by means of wash-water pumps. After filtering, the water will be further chlorinated and stored in a 400,000-gal underground reservoir from which it will be withdrawn and pumped to service as needed.

Three high-pressure pumps furnish water at a pressure of 70 psig for all high-pressure flushing purposes. A hydropneumatic system is used to maintain this pressure in the high-pressure system. If very high pressure is required for flushing or for operation of the portable jet cleaners, two booster pumps can be placed in operation manually. These pumps will boost the pressure in the high-pressure system to 120 psig.

Power comes from two sources. During off-peak hours, all power for general plant use is purchased from the Florida Power and Light Co. However, during on-peak hours in the winter months, part or all of the plant load will be picked up by a 332-kw generator driven by a 480-hp dual-fuel engine in the blower building. The electrical load will be transferred from one system to the other through single circuits serving individual buildings rather than by a transfer of the entire plant load. Thus as many circuits as are required to absorb the generator output can be transferred to it. By this means, the demand on the power company's line during on-peak hours will be reduced with a resulting decrease in power costs.

The generator also serves as a standby unit in case of power failure. It has sufficient capacity to handle all operations except dewatering and incineration. No power circuits are provided from it for these operations, although emergency lighting circuits are supplied to these areas.

The Administration Building contains offices, a meter and records room, a lunchroom, storage room, and a chemical and bacteriological laboratory. The laboratory is furnished with all the equipment required for complete sanitary, chemical, and bacteriological tests, as well as for microscopic work. A walk-in constant-temperature room is provided for work on biochemical oxygen demand. A total of 1,450 sq ft is allocated to laboratory work, including the chemist's office and laboratory supply storage.

The meter and records room contains a meter panel on which all information required for evaluating the operation of the plant is shown as a continuous record. There is storage space in this room for all the record charts removed from the recording instruments throughout the plant and for the weekly, monthly, and annual operating reports prepared from these and other data.

The Maintenance Building contains toilet and locker rooms for all plant operating personnel with the exception of those in the Administration Building. Lunchrooms in this building are equipped with cabinet-type kitchens for warming food, preparing hot drinks, and for storage of employees' lunches under refrigeration.

A machine shop in this building takes care of maintenance needs. Located beside the shop is office space for a maintenance engineer or general foreman and a first-aid room. This building also has space for the storage of spare parts and of paints used in plant maintenance. It is not intended that the paint storage room be used as a paint shop, however, as the special type of construction required to protect it against explosion hazards has not been provided.

A garage with facilities for minor automotive maintenance and repair has been included, as have gasoline storage and dispensing facilities.

The grounds have been graded throughout and a system of drains installed. Paved roads connect the various areas, and areas between roads are planted with grass or ground cover. Trees and shrubs have been planted to give shade and a pleasing appearance. The drains discharge around the perimeter of the plant, and the perimeter is fenced. Lawn hydrants are provided for watering plants and ground cover, and fire hydrants near the Administration and Maintenance Buildings.

The Ocean Outfall consists of 1,700 ft of 108-in. precast reinforced concrete pipe extending from the plant to the water's edge, and of 4,500 ft of 90-in. precast pipe from the shore to the end of the outfall in about 20 ft of water. The last 188 ft contain twelve outlet ports varying in diam-

eter between 24 and 36 in. These outlets are designed to equalize the discharges and to direct the outflowing effluent in a generally horizontal direction in order to secure the maximum of dispersion. A bypass structure is located close to the shore with an emergency outlet at the shore.

Equipment manufacturers are listed by contracts in Table I.

Construction of plant and outfall

The treatment plant is located on what was a mangrove swamp at the northerly end of Virginia Key. Mangrove trees were removed from the site, ample areas for the various structures were excavated, and needed material was dredged from Biscayne Bay and pumped into place. The structures are supported on piles driven through muck and sand to bearing on the underlying stratum, known as Miami Oolite. Approximately 65 acres of swamp were filled with 640,000 cu yd of sand dredged from the bay. An additional 325,000 cu yd for the access road was also dredged from the bay.

Concrete for the structures was manufactured in a batching plant at one corner of the site adjacent to a sheetpiling dock built by the contractor. Access to the dock by boat from Biscayne Bay was through a dredged canal originally dug for drainage but widened and deepened by the contractor to permit the barging of materials and equipment to the site. The sections of precast reinforced concrete pipe used at the treatment plant, and for the ocean outfall, were made adjacent to the batching plant.

Although the original mangrove swamp was at ocean level, and excavation for the structures had to be made into groundwater, the contractor had little trouble in keeping the water out of the excavation. Well points were used extensively, supplemented by trench pumps.

The ocean part of the outfall was laid without undue difficulty. At times swells delayed pipe laying but no hurricanes or other serious weather disturbances occurred during construction. The first few hundred feet of pipe laid offshore were placed between sand levees built along each side of the trench, which acted as cofferdams and also served as roadways for cranes and other equipment. Beyond the levees the trench was dug and the pipe laid from barges. Divers were used to make underwater joints.

Initial plant operation

The treatment plant has been in operation too short a time to permit establishment of routine procedures or the accumulation of operating data indicative of normal operation. For the first three weeks, when only the 4th Street Pumping Station was in operation, the aeration tanks were bypassed and the sewage given sedimentation in the final settling tanks. The settled sewage was chlorinated and the sludge pumped to the digestion tanks.

The aeration tanks were put in operation on October 8, 1956. At first considerable foaming occurred in the first passes but later this was brought under control by adjusting the solids content in the mixed liquor. The best methods for operating the aeration tanks are yet to be worked out. Initial operation was somewhat handicapped by the low flows, by the long detention periods in the force main across the bay, and by pumping out of the septic material in the existing sewers. Hydrogen sulfide initially could be detected at the aerated grit chamber but not at the aeration tanks. This condition was eliminated by heavy chlorination at the mainland pumping stations. Bulking of sludge in the final tanks has occurred, and considerable quantities of light flocculent solids have passed out in the effluent. However, since the first part of February, the plant has been operated as a plain aeration plant preparatory to switching to high-rate aeration, and the bulking problem has disappeared.

Digestion of the sludge began promptly, but because of the unusually high hydrogen sulfide content of the gas (for reasons not as yet determined) gas has not been used for engine operation. The quantity of gas per pound of volatile solids, added to the digesters, has only recently reached the amount expected, and it is anticipated that the hydrogen sulfide content will now steadily decline.

The usual operating bugs connected with starting up a new plant have arisen. Correction will require the determination of causes and application of remedial measures. In spite of these initial difficulties, the effluent in general has been lower in B.O.D. and suspended solids than anticipated. Bugs in equipment have been few and readily corrected. Sufficient sludge has only recently been accumulated to permit testing of dewatering equipment. Incinerating equipment has not yet been tested.

The treatment works are operated under the supervision of the Miami Department of Water and Sewers, of which C. F. Wertz, M.ASCE, is Director, and Garrett Sloan, A.M.ASCE, is Chief Engineer. David P. Backmeyer is Superintendent of the plant.

TABLE I. Equipment manufacturers, by contracts

Contract No. 1. Interceptor sewers

Concrete pipe—Universal Concrete Pipe Co.

Contract No. 2. N.W. 4th Street and N.E. 9th Street Pumping Stations

Automatically cleaned bar racks and hammermill grinders—Jeffrey Manufacturing Co.
Sewage pumps and motors and opposed-piston diesel engines—Fairbanks, Morse & Co.
Angle gear drives—Philadelphia Gear Works, Inc.
Diesel engine generator sets—Murphy Diesel Co.
Power distribution centers and control equipment—Cutler-Hammer, Inc.
Venturi tubes and metering equipment—Builders-Providence, Inc.
Sluice gates—Rodney Hunt Machine Co.
Cone valves and gate valves—Chapman Valve Manufacturing Co.
Overhead traveling cranes—Morris Wheeler & Co.
Electrically operated hoists—Harnischfeger Corp.
Chlorination equipment—Wallace & Tiernan, Inc.

Contract No. 3. Bay crossing

Concrete pressure pipe—Price Brothers Co., Inc.

Contract No. 4. Virginia Key Sewage Treatment Plant

Air diffusion equipment in grit chambers and aeration tanks, "Saran" tube-cleaning equipment, screw-feed sludge pumps—Chicago Pump Co.
Grit conveyors and elevators, sludge collectors and scum skimmers in final settling tanks, conveyors in Dewatering and Drier Buildings—Link-Belt Co.
Equipment in concentration and elutriation tanks—Dorr-Oliver, Inc.
Grit conveying equipment—Pneumatic Ejectors, Inc.
Dual-fuel and spark-ignition engines and auxiliary equipment, sewage and water pumps, high-pressure gas boosters—Worthington Corp.
Grit and main air blowers, vacuum pumps for dewatering equipment, sewage gas meters—Roots-Connersville Blower Div.
Generator—Electric Machinery Mfg. Co.
Floating covers, gas-control equipment and sludge heat-exchangers—Pacific Flush Tank Co.
Sludge filters and auxiliary equipment—Komline-Sanderson Engineering Corp.
Sludge driers and auxiliary equipment—Combustion Engineering, Inc.
Elevated water storage tank and gas sphere—Chicago Bridge and Iron Co.
Scum ejectors and sludge pumps—Ralph B. Carter Co.
Low-pressure gas boosters—Buffalo Forge Co.
Chlorination equipment and controls—Wallace & Tiernan, Inc.
Instrumentation, recording weighing scales in Drier Building, rate controllers in process-water treatment plant—Builders-Providence, Inc.
Power distribution centers and control equipment—General Electric Co.
Prestressed concrete sludge digestion tanks—Preload Co., Inc.
Reinforced concrete chimney—Custodis Construction Co., Inc.
Sluice gates—Rodney Hunt Manufacturing Co.
Air filters—American Air Filter Co.
Basket strainers and automatic strainers on process water supply—Elliot Co.
Combustible gas alarm system—Davis Emergency Equipment Co.
Traveling crane—Harnischfeger Corp.
Large gate valves—Chapman Valve Manufacturing Co.
Butterfly valves—R-S Products Corp.
Cast-iron pipe—American Cast-Iron Pipe Co.
Plug valves—American Car & Foundry Co.
Concrete pipe—Lock Joint Pipe Co.
Open rapid sand filters for process water—Graver Water Conditioning Co., Inc.
Laboratory furniture—Metalab Equipment Corp.

Contract No. 5. Ocean Outfall

Concrete pipe—Lock Joint Pipe Co.

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Laying out true meridians in defense plants

One of the interesting surveying problems that has developed as a result of the continuing defense needs of the country is the placing of true meridian lines inside of defense plants and laboratories to help in the testing of weapon components. The location of these meridian lines can tax the ingenuity of the professional surveyor and represent a challenging and refreshing surveying problem. The author has been employed on a consulting basis for a number of these jobs and believes the assignment described in this article is fairly indicative of the problems involved.

The positions of the points that had to be established inside the defense plant building are shown in Fig. 1. In addition to the three true north-south lines, two true east-west lines were required. The final positions of the points on these lines were to be marked on 1-in. brass plugs set flush with the floor. Two layouts had to be made—the first to give approximate locations for the brass plugs, the second to accurately scribe the final true points on the plugs after they had been carefully set in place in the concrete floor. Because of the nature of the tests for which the lines would be utilized, a directional accuracy of ±5 sec of arc was specified for the lines.

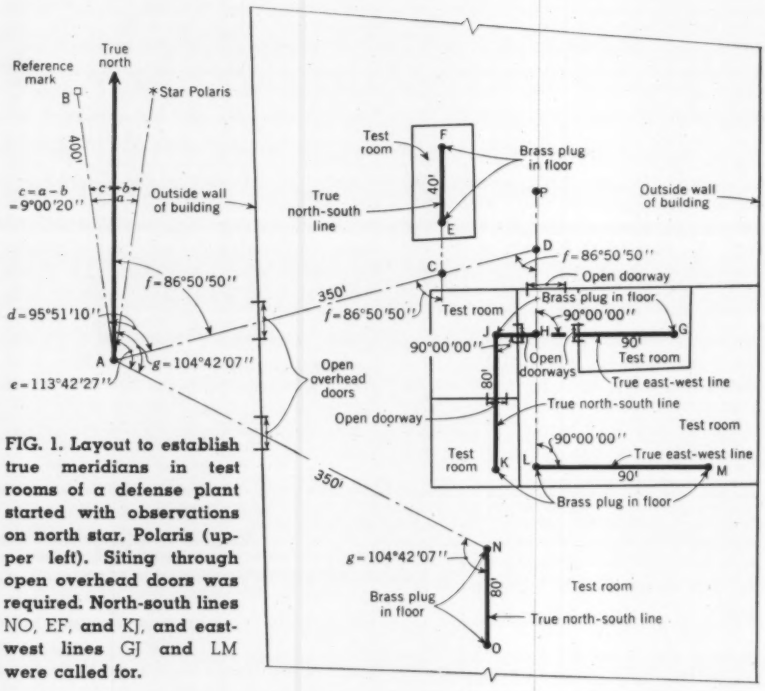


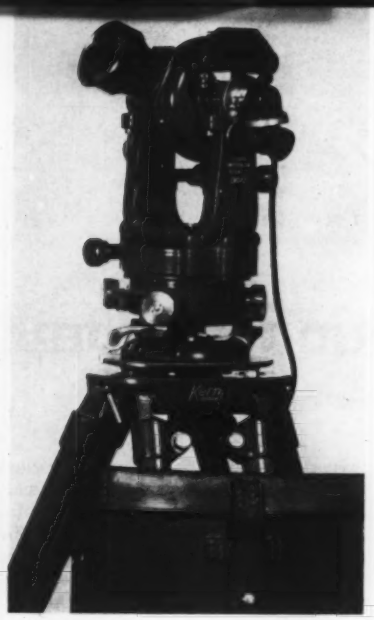
FIG. 1. Layout to establish true meridians in test rooms of a defense plant started with observations on north star, Polaris (upper left). Siting through open overhead doors was required. North-south lines NO, EF, **and** KJ, **and east-west lines** GJ **and** LM **were called for.**

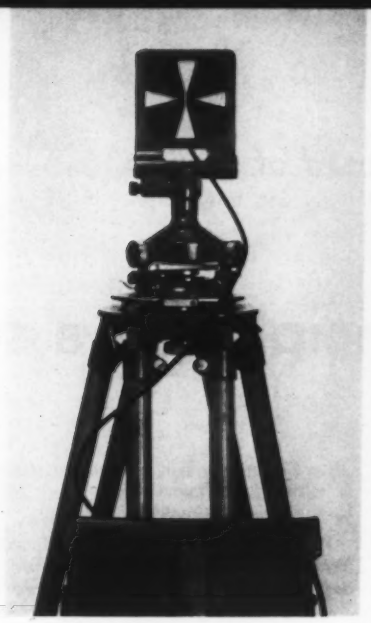
The instrument position *A*, outside the building, was chosen to permit a clear observation on Polaris and also to make possible the establishment of points *D* and *N* inside the building, where the true north-south lines were required. As Fig. 1 indicates, the lines of sight into the building were run through opened overhead doors.

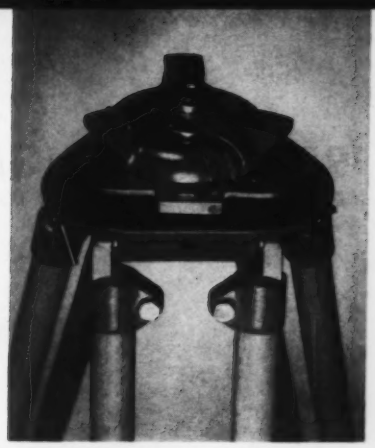
The astronomical observations consisted of sets of angular measurements on the north star Polaris and the reference mark *B*. The instrument used was the Kern DKM 2, an optical reading theodolite, reading directly to 1 sec and with estimation to 0.2 sec. This instrument is equipped with internal lighting facilities and is excellent for astronomical observations. Auxiliary equipment that greatly aided in the accurate layout of the meridian consisted of Kern tripods with centering plates, permitting interchange of theodolite and targets, and electrically illuminated Kern targets (shown in accompanying photographs). An accurate chronometer, checked by short-wave radio against the time signals broadcast by the National Bureau of Standards, furnished the necessary time of observation.

The time of the eastern elongation of the star Polaris was calculated for the night of the observations, and the observations were made as close to the theoretically best time as possible. The angle *a* between the reference mark and the star was measured in a set consisting of two direct and two reversed readings on the star. For the average time of observations for each set of readings, the angle *b*, which represents the azimuth of the star east of north, was calculated by using the appropriate astronomical formulas involving the local hour angle of the star for the instant of observation. The difference between the angles *a* and *b* gave the angle *c*, which represents the true azimuth of the reference line *AB* from north, measured counterclockwise. The resultant angle *c* was determined independently at least four times on the first night of observations, the maximum deviation between the results of the sets being only 2 sec of arc.

Next, the angle *d* between the lines *AB* and *AD* and the angle *e* between the lines *AB* and *AN* were measured precisely by taking the average of sev-







Optical theodolite used in observations here described was Kern DKM 2, reading directly to 1 sec and lighted internally for astronomical observations, seen at far left. In center is electrically lighted target. To permit interchange of target and theodolite, both were mounted on identical tripods like that above.

eral sets, consisting of direct and reversed readings, resulting in the values shown in Fig. 1. The difference between the angles c and d resulted in f, the angle representing the true azimuth of the reference line AD. Similarly, the angle g representing the true azimuth of the line AN was determined. The theodolite at A and the target at N were then interchanged. A check with the optical plummets on the target and theodolite indicated perfect interchangeability of the equipment. This feature of the Kern instruments is very valuable for surveying operations of this nature.

With the instrument at N, the angle g was turned precisely four times direct and reversed, counterclockwise, to establish the meridian line in the test room. On the first night of observations, the points N and O in this room were simply marked on the concrete slab. Instructions were given to the construction staff of the defense plant to insure that when the brass plugs at N and O were placed in the slab they would be centered as closely as possible on the theoretical marks N and O determined as has been described.

In addition to the true north-south line NO marked as described, additional north-south lines EF and KJ, and east-west lines GJ and LM had to be established in the special test rooms indicated in Fig. 1. To establish these lines, auxiliary working points C and H were chosen.

The instrument was placed on D and a sight taken to A, after which C was marked on line. Then H and L were established on a true meridian through D by turning the angle f precisely four times with the telescope direct and reversed, and averaging the results. A backsight point P was established to lengthen the sight required for orientation at H. Then E and F were established on a true meridian through C by placing the theodolite on C and turning the supplement of the angle f four times from the target set on A, with telescope direct and reversed, and averaging the results.

With the instrument at H, accurately centered over the point with the optical plummet, a sight was taken to P on a true meridian. Then a right angle was turned twice with the optical reading instrument and the very small difference averaged to establish G on an east-west line. By inverting the telescope in a direct and reversed position, point J on the east-west line was established. In similar ways the right angles at J and L were turned very precisely to establish the true meridian line JK and the east-west line LM. It should be noted that, although the sights were short, the arrangement used always permitted a longer backsight distance than foresight distance. Also, the sight was directed on a very finely sharpened steel point, which made the pointing very accurate.

After the brass plugs were set in the floor, a return visit was made for the final layout. The azimuth of the line AB as determined previously could have been accepted, since the points A and B probably would not have been disturbed. As a check, however, four new sets of astronomical observations on Polaris were made which checked within 1 sec of the previously determined value of the angle c. In a similar way the angles f and g were checked as closely. The final result for these angles is shown in Fig. 1.

The theodolite was interchanged with the target at D and N, and the angles f and g turned accurately for the final marking of the points on the brass plugs to indicate the true meridian. The procedure described previously with the instrument at C, D, H, and L was repeated very precisely during the final layout to give the final marks on the brass plugs shown on the diagram. To make the results as accurate as possible, fine lines were scratched in on the brass plugs in the direction of the meridian with a sharp awl. Maximum pointing and scribing errors can be calculated to be no more than 2 sec of arc.

On the basis of the many readings taken and the checks used, the writer was able to certify to the defense plant that the result of the layout of the various meridians was well within the requirement of 5 sec of arc of directional accuracy from the true meridian. An unusual surveying job, such as the one described, can be of interest and profit to a professional surveyor, and it is likely that similar problems will be encountered as our defense program continues.

1957 Report of EJC Board of Review

(To be referred to EJC Board of Directors for final action, April 23, 1957)

Principles of a sound national

March 1, 1957

Members of the Council
Engineers Joint Council

In 1950 some seventy-five engineers from all branches of engineering, working under the auspices of Engineers Joint Council, prepared a report on "Principles of a Sound National Water Policy." The purpose of this report was to provide an expression of views of engineers for consideration of the then existing President's Water Resources Policy Commission. Planning and operation of the physical aspects of water resources projects, and to a considerable extent their economic aspects, are engineering functions. Thus this group of engineers with experience in water development brought an extensive body of technical skill and knowledge to the undertaking. The report, published in 1951, represents a sound and thoughtful statement on water policy.

Since 1950 several governmental commissions—President's Water Resources Policy Commission, Commission on Intergovernmental Relations, Materials Policy Commission, Second Hoover Commission, and the Presidential Advisory Committee (1955)—have reviewed phases of water policy. Water policy has been the subject of bills introduced in the Congress and of comments by many individuals and non-governmental organizations. Continued activity in water resource development has also supplied additional experience during the years that have passed. It therefore seemed appropriate that the statement of the Engineers Joint Council be reviewed in the light of any newer facts and opinions and that a succinct restatement of policy be formulated. Accordingly a Board of Review was appointed by Engineers Joint Council in November 1955.

Details of some concepts of the 1951 report have been modified, especially the omission of specific numerical rules and definite methods which do not seem warranted in a statement of broad policy. Some new ideas have been added where experience during the past five years indicates the need. But there is no fundamental change in the basic ideas concerning the role of the Federal Government, the need for integrity in financial analysis, reimbursement, uniform policies, and impartial review of proposed projects.

Respectfully,
Richard D. Hoak, *Chairman*

M. J. Dowd	P. J. Raver
R. G. Folsom	Philip Sporn
L. R. Howson	Abel Wolman
H. E. Hudson, Jr.	Ray K. Linsley, *Secretary*

Dissents are indicated throughout as follows: D=Mr. Dowd, R=Mr. Raver, S=Mr. Sporn, W=Mr. Wolman. Dissents submitted by Mr. Raver were received subsequent to publication of final draft.

Objectives of a Water Policy

The single, fundamental principle of a sound national water policy must be that it meets the needs of the American people. We have not always adhered to this principle and we have been the poorer for it, but the challenge of the future makes it imperative that our water policies be related to our needs, today and for the future.

With our population expected to exceed 200,000,000 by 1975, and with ever-increasing quantities of water required for domestic, industrial, and agricultural purposes, wise use of our water resources presents an important problem for the years ahead. As the energy base for our modern society, electric power has assumed an increasingly important role. In order to provide the abundance of electricity we need and to conserve our fuel resources, our water-power resources should be developed wisely. An increasing population and expanding economy are making new demands for water transportation. Despite our temporary concern with surpluses of certain agricultural products, future needs for food and fiber will create new requirements for the reclamation of potentially productive land and supplemental irrigation of land already in production. A larger population with more leisure time will seek new opportunities for recreation. Paralleling the expanding demands for water use, continuing encroachments on the flood plains are increasing the magnitude of flood damage. Maintaining the quality of our waters requires effective pollution control. Protection of our soil

water policy—a restatement

against erosion and depletion is of vital national concern.

To equate these increasing water requirements with the diminishing opportunities for water development as additional projects are constructed will demand creative, imaginative engineering. Positive action must characterize our national water policies if we are to stimulate the achievement necessary to meet the challenge of the future and provide comprehensive development of our river basins.

The basic principles which should guide water resource planning in the United States are given in the accompanying box, entitled "General Conclusions."

These conclusions are discussed in greater detail in the material which follows.

Basic Concepts

1. To assure the optimum contribution of the waters of the United States to economic growth and national welfare, development and control of those waters are essential. The participation of state, interstate, local, and private agencies in this development should be actively encouraged and expanded, with the Federal Government assuming responsibility within its Constitutional power and when its participation is necessary to serve the national interest.

2. It is customary to consider water resources as renewable and therefore inexhaustible. But the physical sites at which these resources can be developed are limited in number. Planning must therefore be long-range if proper use of water resources is to be accomplished.

3. The possible expenditures for water resource development are enormous but the labor, material, and money available at any particular time for construction of such works are limited. It is important, therefore, to devote the available labor, material, and money to those projects which will make the maximum contribution of benefits rather than to those that are merely feasible. It is essential that all projects be geared to the national economy and carefully planned to serve their intended purposes. Projects are not so urgently needed that they must be designed and constructed without adequate and reliable data.

4. Reports on a project should be presented with the utmost integrity—clearly stating the short and long-range effects of the project and accurately summarizing the expected costs and benefits. Intangible or indirect benefits may influence the final decision, but, in any case, they should be presented against a scrupulously accurate background of direct and tangible facts, and of intangible and indirect costs and losses.

5. The planning of water-resource projects should fully recognize the roles of both surface and ground water in water supply and the importance of planning land use jointly with water use.

6. Because there are now inconsistencies in national water policies; because the pertinent policies of various federal agencies should be better coordinated; because there should be greater coordination of federal and state functions, interests, authority, and rights; because the demands of water resource development, in terms of money, labor, and material, are of tremendous magnitude and because there is need for continued comprehensive development of water resources, there is definite need for a unified national water policy.

7. It would be contrary to the Nation's interests to force all water projects into a rigid and inflexible framework. A sound water-resource policy should embody some flexibility and adaptability of methods and purpose.

General Conclusions

1. Subject to the principles of economic justification set out later herein, plans for the development and use of water resources should provide for maximum utilization of these resources. The objectives of such resource development should include the safeguarding of our resources against deterioration from soil erosion, wasteful forest practices, and floods; the improvement and higher utilization of these resources to support an expanding economy and national security; assistance to regional development; expansion of all types of recreational opportunity to meet increasing needs; and protection of public health.

2. Consideration and control of the waters of the United States are in the national interest, but not necessarily a function of the Federal Government. On the contrary, that which can be done by the individual [1-R] should be done by him and that which requires collective action should be done at the lowest governmental level practicable.

3. Beneficiaries of federal water-resource projects should reimburse the Federal Government for their equitable shares of the project costs [2-R].

4. Project reports should be clear and forthright, presenting all costs as accurately as possible, proposed reimbursement plans, and the amount of federal subsidy, if any.

5. All projects within a river basin should, where practicable, be coordinated within the framework of a comprehensive plan which will assure maximum effectiveness in the development of the basin.

6. There should be a Board of Review for the impartial analysis of all federal water-resources projects.

7. All federal agencies engaged in water-resource development should conform to the same basic policies.

For footnotes, see page 55.

Federal Participation

It is recognized that the Federal Government has a significant role to play in the development [1-S] of water resources. In its exercise of that role, the Federal Government should assume the initiative in development, if and when: (1) an economically justified project is of such magnitude as to be beyond the means of local groups, or (2) such a project is so complex that no clearly defined local group or groups can be identified as principal beneficiaries, or (3) the participation of the Federal Government is necessary to assure the maximum development consonant with a comprehensive regional and basin plan. As to other projects, state, interstate, local, and private interests or agencies should be encouraged to undertake them, when consistent with a reasonable comprehensive plan. The development, ownership, operation, and maintenance of water resource projects should be kept as close as possible to those who use and benefit from them. To that end, those groups should be permitted, on a fair and equitable basis, to acquire title to and to operate and maintain projects constructed by the Federal Government [3-R]. In some cases new federal, state, or local legislation may be necessary to implement this.

Rate of Development

Development of water resources should be kept in pace with national and regional needs, and plans should be made in the light of increasing requirements of the future. Plans should be based on adequate data, properly interpreted, to assure that a proposed project will serve its intended purpose or purposes effectively. No project is so urgently needed as to justify its design or authorization without prior complete and orderly review.

Basic Data

Adequate and reliable data are essential to a sound program of water resource development. Federal expenditures, for the collection of such data; for research on improved methods of data collection, utilization, and interpretation; and for prompt and effective publication of collected data, should bear a realistic relationship to current and projected expenditures for water and land development. At the same time, the responsibility of state and local governments for collection of data necessary for solution of local water problems should be recognized and implemented in a policy of federal-state-local participation. In addition to all forms of hydrologic data (including water quality), basic data for water resource planning should include such items as flood damage information, classification and uses of land and soil, demography, topographic and geologic mapping, economic information, and the results of research in hydrologic principles, hydraulic design, and construction materials and methods.

Planning

(*a*) Planning and implementation of all federal water resource projects should be in strict conformity with basic federal law and should fully recognize pertinent state laws and rights.

(*b*) In so far as possible the principles governing the planning, evaluation, repayment, design, and operation of all federal projects should be the same regardless of location, purpose, or constructing agency.

(*c*) The national interest demands that projects within a single river basin, whether they be federal, state, private, or combinations of such interests, be coordinated to provide maximum effectiveness. Every project report should show clearly that the project is in substantial agreement with a reasonable overall plan for the basin. But each individual project within a basin should be independently justified prior to authorization. The interrelation of the proposed project with other projects (existing and potential) within the comprehensive plan should be fully evaluated. A project is defined as a single development or a group of interrelated and mutually dependent works constructed essentially simultaneously [4-R]. It may serve one or more purposes.

(*d*) The states should be encouraged to establish state water resource planning boards, or, by compact [5-R], interstate agencies to represent state and local interests in planning federal water projects and, where appropriate, to plan for state and local participation in the actual development.

Federal Board of Review

A Board of Review of not less than five members should be created. Members of the Board should be appointed primarily on the basis of ability and experience in the field of water resource development [5a-R]. A majority of the Board should be selected from other than federal employees. Their terms of office should not be less than five years and for continuity should be staggered. A report of the Board of Review should accompany each project report to Congress, and such review and report should be prerequisite to authorization or appropriation by Congress. The Board should, among other things, appraise the adequacy and reliability of the data incorporated in project reports, the accuracy of interpretation of those data, and the relative importance of the project in the national scene. The Board should periodically review basic national water policy and make recommendations with a view to adjusting policy to changing national conditions. The Board should also periodically review national water problems and report on desirable elements of a broad, long-range program and on the cost of and results achieved by completed projects as compared with those intended.

Economic Justification

(*a*) The Federal Government should undertake projects only when they will increase the wealth of the nation. As a measure of the direct economic effects of a proposed project, the ratio of annual benefits or values to annual costs should be computed, using direct tangible benefits and costs expressed in monetary terms. Because without an excess of benefits over costs there can be no increase in the national wealth and because the national good requires construction of the best projects first, a benefit-cost ratio substantially [6-R] greater than one should be required. If, however, intangible benefits are shown to be large and certain, authorization of an occasional project with a direct benefit-to-cost ratio less than one may be justified.

(*b*) The costs reported for a proposed federal project should be detailed and thoroughly inclusive. All items of first cost, including cost of investigation, lands and rights-of-way, construction, interest during construction, and the cost of measures needed to correct detrimental results of the project, should be presented. The costs of all components of the project required to achieve its intended purpose, including costs to others than the Federal Government, should be included in the cost summary.

The estimates of annual costs should include those for operation and maintenance, interest on the unamortized amount of first cost, proper allowance for taxes (*paid or foregone*), [1-D] [7-R] amortization, replacements (to the extent required during the period of amortization), and allowance for insurance (or its equivalent) and contingencies.

Costs to be borne by non-federal participants should also be included in the cost summary. Estimates should be clearly indicated as such, and where of doubtful accuracy should include the maximum and minimum of the range of the cost estimates.

(*c*) In calculating the annual cost of the project, amortization should be assumed to take place within the useful life of the project or within a maximum of 50 years, whichever is less [4-R].

(*d*) The money rates used for calculation of project costs should cover all costs of securing money for the project.

(*e*) The expected benefits [2-S] of water resource projects should be itemized in detail and expressed in average annual monetary terms. All direct benefits, including those to be received by nonfederal participants, should be included in the appraisal of a project. Secondary benefits reflecting the increases in national income resulting from the project should be considered mainly with respect to the timing of a project (such benefits may be more important during periods of low business activity) or in choosing among otherwise equivalent projects. All benefits should be estimated by the interested agencies according to a uniform procedure developed with the approval of the Board of Review.

(*f*) Any expedient to give unsound projects the benefit of surplus values which may accrue from sound projects should be avoided. Basin accounts may be used when in accord with normal, sound business practices.

Reimbursement

(*a*) The identifiable beneficiaries (both direct and indirect) of a federal water resource project should reimburse the Federal Government fully for their shares of the project costs. No federal project should be constructed until the identifiable beneficiaries have arranged to contribute an equitable portion of its cost [9-R]. The contribution may be in the form of land or rights-of-way, of payment for vendible products or services, or of taxes or assessments levied by state and/or local taxing authority. Payment for vendible products or services should be in the full amount of all costs involved in providing such products or services. All reports on the project should show the cost allocable to the beneficiaries, the portion of the cost to be repaid, and the amount of the federal subsidy, if any.

(*b*) All income from federal water resource projects should be paid into the general funds of the federal treasury and be disbursed only pursuant to appropriations by Congress. Revolving funds for construction should be eliminated [10-R].

(*c*) Reports on multiple-purpose projects should show the allocation of cost between the several functions of the project and to the identifiable beneficiaries and the nation as a whole, as a basis, among other things, for judging the equity of proposed reimbursement schedules. The Board of Review should prescribe the methods to be used for cost allocation.

(*d*) Cost of operation and maintenance of completed projects should be borne by the beneficiaries of the project [11-R].

Authorization

(*a*) Authorization of federal projects or federal participation in projects sponsored by state, interstate, local, or private agencies should be solely by Congress, on the basis of reports prepared by the sponsoring agency and reviewed (although not necessarily concurred in) by interested state and federal agencies and by the Board of Review. No deviations from this principle of review should be permitted.

(*b*) Authorization should be for individual projects or units of a comprehensive plan, each of which units is in actuality a project. Subsequent increases in cost of or proposals for deviations from projects as authorized, which result in a change in purpose or substantial change in cost, should again be reviewed by the Board of Review and approved by Congress before implementation.

Coordination Among Federal Agencies

In order to eliminate duplication of activities, there is an urgent need for Congress to define specifically the role of each federal agency engaged in water resource investigation and development. All federal agencies should be required to conform to the same basic principles. Congress should also seek means of better coordination of the various federal, state, local, and private agencies, particularly with regard to planning and operation of river basin programs.

Recreation, Fisheries, and Wildlife

(*a*) The preservation of fish and wildlife resources is important to the nation, both commercially and for recreation. A report on any water resource project should include an appraisal of its effect on fish and wildlife resources and, if the effect be harmful, should recommend any desirable corrective measures including the cost thereof. Facilities for recreation are an important part of the American way of life.

The benefits of recreation and fish and wildlife preservation may be large but are usually impossible to evaluate in monetary terms. No assignment of monetary benefits should be made except where there are clearly definable benefits to commercial fisheries, collectible fees for admission or concessions, or money contributions by state and local interests. In view of the value of recreation, fisheries, and wildlife, Congress should appropriate annually a specific sum of money for improvement and development of these functions and allot the same to individual projects.

(*b*) That portion of the construction cost of a project allocated to recreation, fisheries, or wildlife should not be greater than the actual cost of the facilities provided.

(*c*) Where feasible, local interests should be encouraged to develop the recreational aspects of federal projects and to contribute a portion of the capital

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[1-D] dissents from inclusion of this parenthetic clause.

[1-R] I would insert: ", without destroying the values of comprehensive river basin programs,"

[2-R] This sentence should be prefaced with the phrase, "To the maximum extent possible and consistent with the general welfare."

[3-R] I would add, "providing the public interest is protected in such transactions."

[4-R] I would eliminate the words "constructed essentially simultaneously." The definition in this respect is too restrictive. The Federal Power Commission has not followed this definition in granting licenses for groups or private power dams.

[5-R] Since experience to date gives no assurance of the workability of state compacts, I cannot join in this part of the recommendation.

[5*a*-R] I would add, "A broad outlook toward regional development should be one of the important qualifications for a member of the Board of Review."

[6-R] I would eliminate the word "substantially."

[7-R] I agree with Dowd. To include "taxes foregone" loads the costs artificially.

[8-R] The "payout" requirements might as a matter of public policy be maintained at a maximum of 50 years. The annual cost of the project, however, should be computed on a cost accounting basis, thus improving the cost benefit ratio where dams or other works have a life expectancy of more than 50 years.

[9-R] This requirement could be a serious barrier to the progress of a needed project and is, in my opinion, impractical and too restrictive in carrying out basic public policy. I would eliminate this sentence.

[10-R] I would prefer the sentence to read: "Revolving funds for construction should be subject to annual review by Congress."

[11-R] Such a generalization is unworkable. For example, it would be impractical in many cases to define all of the beneficiaries of a flood control reservoir and assign to each of them a proportionate and equitable share of the cost of operation and maintenance. Consequently, I would add: "to the extent feasible."

[1-S] This statement omits the essential condition that initiative and participation by the Federal Government fall within its Constitutional power and the *preferable* further condition that national interests be predominant.

[2-S] This statement re benefits is deficient in two respects: (1) It fails to point out that benefits must be *net*, i.e. after deducting all costs to beneficiaries in attaining these benefits. (2) Costs, per (*b*) above, include only out-of-pocket expenditures by all project participants, federal and non-federal. Therefore, unless losses or detriments resulting from the project and involving no out-of-pocket expenditures on the part of participants are treated as *negative* benefits, they are not herein taken into account. See 1951 Report, pp. 199 (first full paragraph); 201 (second paragraph under proposition 6).

investment for recreation. The full cost of operation and maintenance of federal recreational facilities should be recovered through admission and concession fees and/or state and local contributions [12-R].

Pollution Control

(*a*) Federal participation in pollution control should be limited to administration of federal laws, research, and technical aid to states and municipalities [13-R].

(*b*) Federal water development projects should always be planned so as not unnecessarily to aggravate pollution problems and, in so far as practicable, so as to improve downstream conditions. If modification of project plans would result in stream improvement, any substantial additional cost of such modifications should be financed by state and local interests.

Municipal and Industrial Water Supply

Development of water supply for municipal and industrial use is the responsibility of local interests. The Federal Government should undertake no projects exclusively for municipal and industrial water supply, except to serve federal installations. Many federally constructed water resource projects will have potential value for municipal and industrial water supply, and the growing needs of communities for water supply should be considered in connection with the planning of comprehensive basin programs. All such projects should be coordinated with the plans of local interests, and facilities should be included to furnish the required water, provided the local interests finance [1-D] the full cost allocated to water supply.

Navigation

(*a*) The development of waterways for navigation should be planned as an integrated part of the overall transportation system of the country. Waterways should be developed only when they offer a significant improvement in transportation and real savings in transportation costs. Federal waterways costs should not be viewed as a yardstick for other transportation costs or charges or used as a means artificially to depress charges for transportation by other carriers.

(*b*) Navigation projects for which current operation and maintenance costs exceed the benefits to the users should be discontinued, except in unusual cases where serious disruption to communities or regions would result, or where full potential use of the project has not been developed but is reasonably certain of development.

(*c*) Navigation projects serving mainly a single beneficiary, or which are of local effect and without significance to the country as a whole, should be paid for by local interests.

(*d*) Recreational boating benefits of navigation projects should be considered as part of the national recreation program.

(*e*) There should be legislation providing for equitable charges for the use of federally constructed waterways. This legislation should be formulated as a part of the whole problem of reconciling and making workable a coordinated transportation system. Such legislation may distinguish between existing canalizations, where possibly reimbursement for only the costs of operation and maintenance might be deemed an equitable solution, and new canalization, where reimbursement for all elements of cost should be required.

Flood Control

(*a*) Flood control should be considered as an important part of water resource management. Consistent with other aspects of the basin program, flood storage should be located and designed to assure the greatest possible use and re-use of flood waters in the course of their journey to the sea.

(*b*) Projects which are solely or primarily for the alleviation of intrastate or purely local flood problems should be constructed by state or local interests, except that, where such intrastate projects are so extensive as to be beyond the financial means of local interests and where the federal interest is predominant, they may be constructed by the Federal Government following an agreement by local interests to repay an equitable portion of the costs.

(*c*) Flood control reservoirs affording flood protection along a considerable portion of an interstate stream and flood control works which are part of an integrated flood control plan for a large stream, with major benefits to interstate commerce, may be constructed by the Federal Government. Such construction should be preceded by an agreement by the local interests or the states concerned to provide necessary land and easements; to repay the Federal Government an equitable portion of the cost in proportion to benefits received; and to pay an appropriate share of the cost of operation and maintenance [14-R].

(*d*) Any report on a flood control project should include a study of all feasible means of minimizing economic losses from floods. The report should show clearly that the recommended project utilizes the optimum method or combination of methods. Recommendations for reservoirs which will flood existing towns or large areas of agricultural land should establish clearly that no other method of flood protection would meet the essential need.

Flood-plain zoning and flood forecasting should be considered in all flood control project reports. If flood-plain zoning is not recommended in the report, there should be clearly stated reasons why zoning would be ineffective or infeasible. If zoning is recommended, federal construction or participation in the cost should be contingent on the enactment of the necessary zoning ordinances.

(*e*) Physical works for the control of floods may not always be in the public interest. A program of actuarially sound flood damage insurance may be a desirable and economic alternative to other flood control measures, especially in the case of the rarer floods.

(*f*) For the benefit of the general public, reports proposing flood control projects should state clearly the degree of protection offered by the proposed plan.

Watershed Management

(*a*) Benefits from the management of land for the control of runoff and erosion are largely local in nature but in some cases may also have some national aspects. Federal participation in land management work should be limited to management programs required for the public lands of the United States and to technical advice and encouragement to private owners to induce them to undertake management programs on their lands.

(*b*) Conservation practices should be fully initiated on watersheds concurrently with or prior to the construction of upland detention reservoirs. But there is no reason to delay downstream flood control projects pending completion of headwater work.

(*c*) One important goal of the management of forest lands is to obtain the maximum of water. The Federal Government should emphasize and encourage research in this field.

Reclamation

(*a*) Lands awaiting reclamation are not deteriorating; they constitute a reserve for future needs. At the same time, substantial increases in production are possible at relatively low cost through supplemental irrigation and improved farming practices in humid areas and through rehabilitation of existing reclamation projects. Before federal participation in a reclamation project is authorized or detailed planning is undertaken, there should be required a demonstration that the project is important to the national economy. The extent to which individual reservoirs are integral parts of comprehensive basin

plans serving other important purposes should also be taken into consideration.

(*b*) Federal participation in a reclamation project should be authorized only on the condition that the total federal construction cost allocable to reclamation be repaid by project revenues. Project reports should show the portion of the total construction cost allocable to reclamation, and the portion of this cost allocable to reclamation which is to be repaid by the water users and the portion to be repaid by indirect beneficiaries or by power or other project revenues. Project reports should also show the total amount of interest on the federal construction cost allocated to reclamation which is foregone by the Federal Government. The portion of the construction cost allocated to reclamation which is not repaid by the water users or indirect beneficiaries, together with interest foregone by the Federal Government, constitutes a subsidy and should be so designated. In addition, the water users should pay the portion of the annual cost of maintenance and operation of the project allocated to reclamation.

(*c*) The total federal cost allocated to reclamation in any project should be repaid to the treasury within a total period of fifty years. Annual payments, except during a development period of not more than ten years, should be uniform over the repayment period. Any outstanding obligation should be permitted to be paid at any time in a lump sum calculated at the then present worth of such obligation based upon interest at the cost of money to the Federal Government.

(*d*) Reclamation by drainage and supplemental irrigation in humid sections of the country can usually be accomplished at relatively small cost and should properly be the responsibility of state and local interests, with federal technical assistance if necessary.

(*e*) The same conditions of authorization, repayment, and technical assistance should apply to all land reclamation projects regardless of the method of reclamation or the agency constructing the project.

Power

(*a*) Production of power for domestic and industrial use is the responsibility of local interests [15-R]. The Federal Government should not undertake any water resource projects exclusively for power development except as required to serve federal installations.

(*b*) The production of power at multiple-purpose projects in every case where it adds to the economic soundness of the project is justified and desirable, and maximum power production consistent with the primary purposes and economic soundness should be provided. But under no circumstances, other than to meet emergency needs of national defense, should such production be permitted to interfere with the efficient operation of the project for its intended primary purpose or purposes.

(*c*) Sale of federal power should be at the generating station except where transmission is necessary for the Government's own use, for proper integration with other federal power plants, or for the equitable disposal of the power. [1-W] [16-R]

(*d*) Power from federal projects should be sold at the lowest possible rates consistent with sound business principles [17-R], provided that the actual annual power income from a project should be equal to the estimated annual power value upon which authorization of the project has been predicated, but not in excess of market value. The rates charged for power from a federal project should properly reflect the annual costs actually incurred [2-W] by the Government (see subsection (*b*) under Economic Justification). Power rates should not be burdened with costs properly chargeable to other purposes of the project.

(*e*) When irrigation is one of the project purposes, Congress may reasonably appropriate the equivalent of surplus power revenues to subsidize any portion of the costs allocated to reclamation which is beyond the ability of the water users to repay [18-R]. The total of annual costs of the project repaid directly or indirectly out of power revenues should not exceed the corresponding costs of the most economical alternative power project.

(*f*) The operation of federal hydroelectric power plants should be integrated with other power production in the area, to the extent that this is practicable and can be done to mutual advantage without interfering with the intended primary purpose or purposes of the project.

(*g*) Local enterprise should be encouraged and given priority over the Federal Government for development of power sites and for development of power at federal multiple-purpose dams, providing such local development is subject to proper governmental control and is consistent with long-range, basin-wide plans [19-R].

(*h*) [2-D] The existing provisions of law giving preference in the purchase of federally generated power to public bodies and cooperatives are inequitable. These provisions should be repealed and replaced with laws which encourage and protect cooperative arrangements between private, local, state, and federal agencies which decrease the financial responsibility and control of the Federal Government, but which do not prevent necessary federal leadership [20-R].

[1-D] would substitute for "finance" the clause "agree to pay with interest."

[2-D] dissents from the inclusion of paragraph (*h*).

[12-R] There is a finality about this statement that doesn't seem to be fitting in view of the broad endorsement of recreational facilities covered in (*a*). I would therefore add, "to the extent feasible."

[13-R] This policy represents too restrictive a view of federal responsibility in pollution control and does not face up to the problem of how a downstream state is to control the pollution originating in an upstream state. Consequently, I would add: "except where it is necessary for the Federal Government to intervene to protect downstream states."

[14-R] The proposal of the last sentence is restrictive and impractical. The following statement would be a more practical guide: "The local interests concerned, where they can be identified, should repay the Federal Government an equitable portion of the costs in proportion to the benefits received."

[15-R] Change the first sentence to read: "While the production of power for domestic and industrial use is largely the responsibility of local interests, adequate supplies at reasonable rates are vital to our national welfare and hence of concern to the Federal Government."

[16-R] I would change this sentence to read: "Sales of federal power should be made under terms and conditions which are in the public interest and transmission lines should be constructed where necessary for the Government's own use, for proper integration with other power plants or systems, for the equitable disposal of the power and as instruments for carrying out sound public policies."

[17-R] I would eliminate everything in the first sentence after the word "principles."

[18-R] I would add the following sentence: "The local or regional power users should not be required to subsidize unduly the cost of a development which is found to be in the national interest."

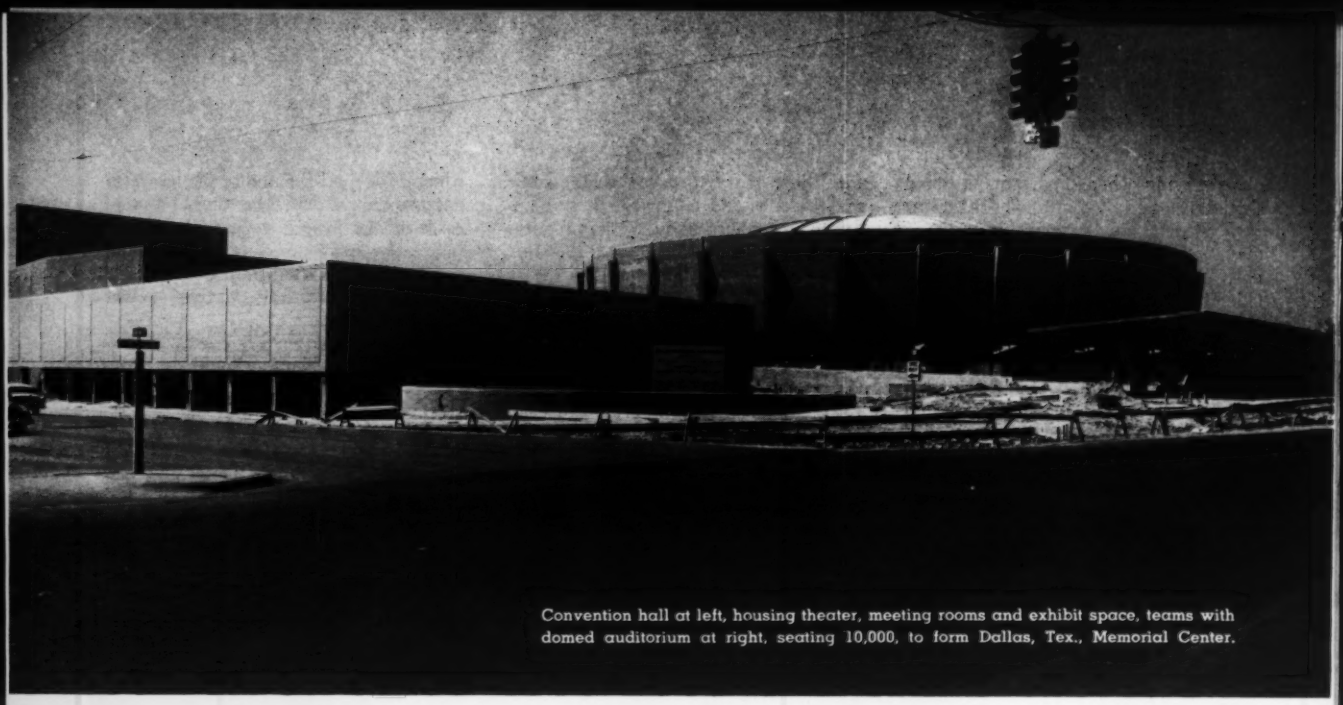
[19-R] I would add the following sentence: "However, sound engineering does not bow to a rigid doctrine that local enterprise take priority over the Federal Government at the cost of underdevelopment."

[20-R] I join with Dowd in dissent of (*h*) and desire to have the following included in my dissent: "The preference laws are a matter of long-standing public policy based on the desirability of maintaining public agencies as a check on the growth of private monopoly. They are a part of a significant body of laws comprising the checks and balances in our system of government. To repeal those laws would result in giving the preference for federal power to the private utilities and thus encouraging the development of monopoly control instead of checking its growth."

The second sentence should be rewritten as follows: "Cooperative arrangements between private, local, state and federal agencies which decrease the financial responsibility and control of the Federal Government but do not prevent necessary federal leadership should be encouraged."

[1-W] Duplication of existing transmission facilities should not otherwise be permitted. In any case, such duplication should, if possible, be avoided.

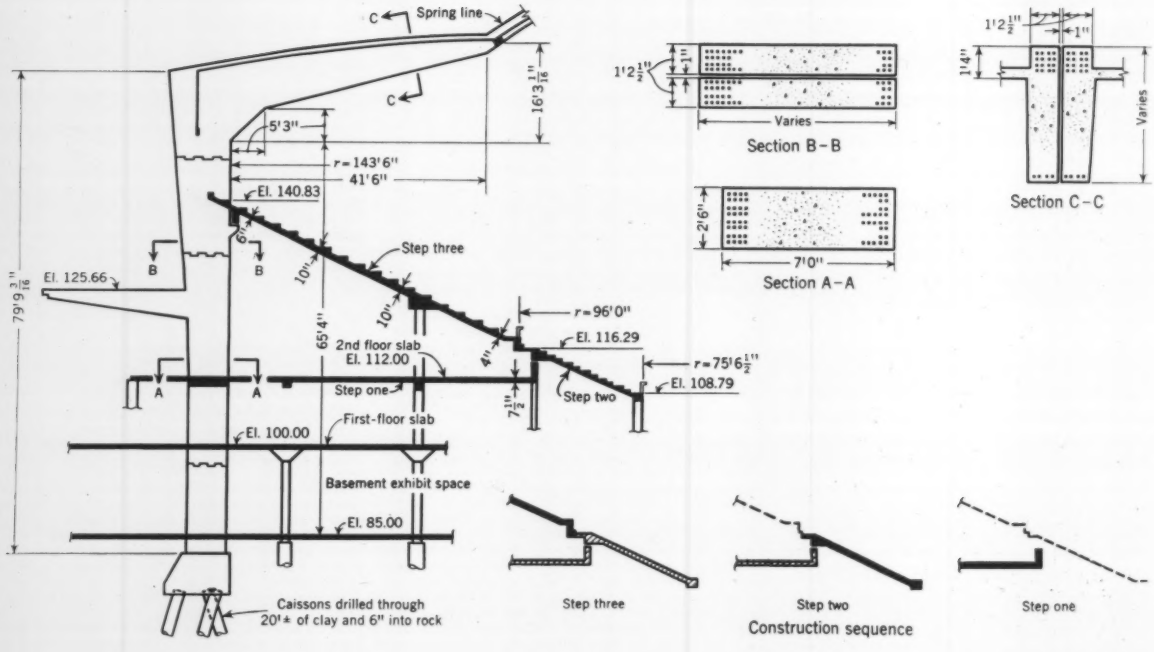
[2-W] In federal projects, taxes foregone are just as much real costs as any other item.



Convention hall at left, housing theater, meeting rooms and exhibit space, teams with domed auditorium at right, seating 10,000, to form Dallas, Tex., Memorial Center.

Cantilevers support dome

BOYD G. ANDERSON and ALLAN D. ANDERSON



# of 204-ft radius

Respectively Associate Partner and Structural Engineer, Ammann & Whitney, New York, N. Y.

Another imposing building, planned for completion in June of this year, has joined the list of long-span auditoriums erected in recent years. In this building a dome of 204-ft radius is supported by cantilevers from the columns to provide a clear span of 300 ft. The columns, 70 ft high, have 45-ft arms cantilevering inward at the top, as shown in Fig. 1. Construction economies were secured by dividing the dome into 16 pie-shaped elements and by utilizing flat slabs extensively as grandstand framing, as will be described.

This 10,000-seat auditorium is teamed with a convention hall to form the Dallas Memorial Center. It is admirably placed on a rolling 26-acre site near downtown Dallas, Tex. The arrangement of the auditorium permits direct access to the basement level, the main-floor level, and the grandstand level from various parking areas accommodating 1,000 cars, located around the building. Handsome promenades link the separate buildings and connect to a covered loading platform where extensive public transportation facilities are provided.

The Convention Center is essentially a theater including adjoining rooms and exhibit space. The auditorium is a larger building seating 10,000 people in stands rising around the multipurpose main-floor hall. Large floor areas for exhibition space are provided in the full basement. Concessions, public rooms, and meeting rooms occupy areas under the grandstand framing.

The buildings of the Memorial Center are enclosed by curtain walls of economical, finely detailed light brown brick of a pleasing color and texture. There is just enough glass and exposed concrete to express the character of the structure.

Structurally, the main buildings are simple in concept, with clean-cut lines devoid of complicated shaping and interlacing of members. This structural simplicity had the aim of reducing construction problems to a minimum, and was no doubt influential in procuring the relatively low bids obtained from the various contractors.

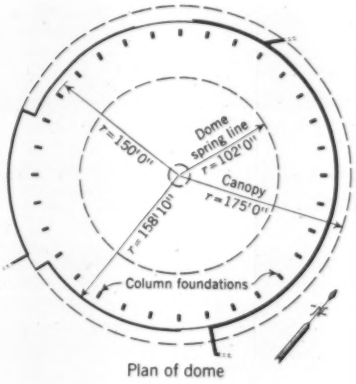
As the functional planning of the auditorium developed under the direction of the architect George L. Dahl, a circular plan with a clear diameter of 300 ft was found to provide best for the multiplicity of uses intended for the main auditorium area. Favorable cost compared to other materials, and the desirability of a heavier roof mass for acoustical purposes, coupled with the advantages of fireproofness, durability, and low maintenance led to the choice of reinforced concrete for most of the framing.

The initial structural planning contemplated the use of a dome of 300-ft clear span, prestressed at the base and supported by a line of columns located around its periphery. Consideration was next given to forming this dome by the use of precast sections, the precast forms serving both to reduce the cost of the falsework and to provide a ceiling having the delightful decorative effects used so well by Nervi and others in the past. However, the cost of formwork plays such a major part in determining the total cost of shell construction that this idea was abandoned, and the roof was separated into a large number of relatively small arched pie-shaped rib elements, thereby permitting the use of a small area of the expensive roof formwork.

The structural scheme accordingly became a dome separated into 16 equal parts, each segment supported at its outside edge by three vertical legs 75 ft long, the two outside legs being common to the abutting segments. Each segment of the dome and the vertical legs are completely separated down to the level of the exterior canopies except for the common central plate at the top of the dome. This separation prevents ring stresses due to volumetric changes and deflections of the bent under external loads that would otherwise stress the skin and upset the balance of internal forces in the frames. Press rooms, mechanical rooms, and other elements suspended from the roof structure are also separated into circumferential units by sliding joints.

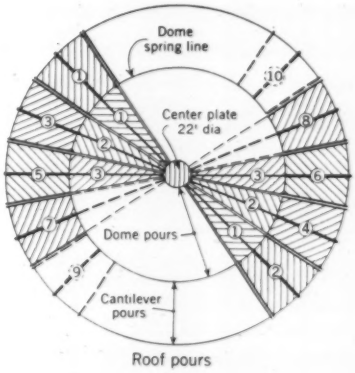
Separating the dome and cantilever into small sections permitted concreting the sections in opposing pairs, each pair being a completely stable and self-supporting arch unit during construction. A center plate 22 ft in diameter, cast with the first pair of dome segments and doweled to the succeeding

FIG. 1. Construction of exterior columns and cantilevers is followed by dome erection, then by construction of second floor, loges, and balcony. Note details of split columns and ribs (Sections B-B and C-C) on facing page, and plan of dome below.



Plan of dome

FIG. 2. Sequence of work for roof cantilevers and roof pours is indicated by circled numerals.



Roof pours

segments, tied all 16 segments together. The relatively small areas of falsework required for each pair of roof segments could be easily lowered and moved for use on succeeding segments. See Fig. 2. The total concrete and reinforcing steel was not materially increased by the separation into segments. Building a form for one eighth of the dome resulted in large savings.

To reduce the size of the vertical columns supporting the roof, the diameter of the dome was reduced by moving the springing line of the dome inward on nearly horizontal frames cantilevered from the exterior column legs. This reduced the total thrust of the arched dome segments by reducing the span of the arch. At the same time the vertical reaction of the dome on the ends of the cantilevers produced a counter-moment balancing the moments caused by the reduced outward thrust (Fig. 3). Further reduction of the moment in the vertical leg caused by the thrust of the dome was obtained by hanging from the cantilevers the light structural steel framing for the press, fan, and mechanical rooms that encircle the arena. In addition to the stress advantages gained by cantilevering the roof dome, this method of framing dropped the roof line and appreciably reduced the height of the formwork and the enclosed volume of the building.

The vertical legs of the bents are tied at the first-floor level by the first-floor slab, which is designed to carry a combined bending due to vertical floor loads plus an axial tension due to the roof thrust. The cantilevered section of the roof outside the arched dome is closed by another thin shell having a relatively large radius of curvature.

Design for economical forming

To reduce the cost of the extensive balcony areas, a flat-plate system of framing was substituted for the more usual method of using thin riser treads to span between heavy radial girders. Treating the balconies as plate slabs added somewhat to the quantity of concrete, and because of the greater weight, also added somewhat to the reinforcing steel. But lower total bids were achieved because the moving and reuse of falsework were greatly facilitated by this design.

The various levels of the balcony were accordingly designed so that several sets of traveling falsework, each about 60 ft long, could follow one anther around the periphery of the building, forming successive floor levels. The upper ends of the grandstand framing are carried on brackets formed into the legs supporting the main roof structure. Supports for these slabs are provided with sliding bearing plates resting on brackets to limit the stresses caused by deflections of the bent legs. As each cantilever element and each pair of dome segments are stable, self-sustained units, work on the grandstand and lower framing could be started as soon as the roof elements were decentered.

The first-floor framing is conventional flat-slab construction in the area of the main arena floor, with beam-and-slab framing around the periphery. The ramp slabs, with integral upturned railing sides, form a channel-shaped beam spanning between the main bent legs. The roof bents and ramp slabs are independent of the retaining walls, which were designed to withstand earth embankments. The depth of these embankments varies from zero where the basement wall is fully exposed, to a maximum of 28 ft. Because of this unbalanced load the walls were designed as free-standing retaining walls to prevent lateral displacement of the roof supports.

More severe criteria than required by the Dallas code were followed in the design of the main long-span roof. Typical vertical live loadings used were:

First floor	150 psf
Ramps and corridor areas	100 psf
Grandstand areas	100 psf
Press room and galleries	50 psf
Auditorium roof	30 psf
Stage	150 psf

The floor slabs and grandstand framing were designed both for full loading and for partial panel loading that would produce maximum slab moments and maximum eccentricities in the columns. In addition to the vertical load, the 10-in. first-floor slab, which acts to tie the roof structure, was designed for combinations of maximum roof thrust and half the vertical live floor load, placed in patterns causing maximum stress conditions, or for the condition of dead load plus half the live load on the roof combined with the full vertical live floor load, placed in similar patterns. Except for the center floor panel of 50-ft clear-span diameter, all reinforcement in the slab was placed radially and circumferentially.

The main roof dome and cantilever were designed for the simultaneous application of dead load, wind load, a 30-psf live load, and a 50-psf live load on the press-gallery areas, plus the effect of volumetric changes. All live loads were considered as a variable load distributed through a number of different load applications so as to provide separate critical conditions of stress at various points in the structure.

The most critical of either a temperature rise of +30 deg F or an equivalent temperature drop of −50 deg F (including shrinkage effects) was combined with the effects of other loading conditions.

Moments and thrusts caused by deflection of the structure were added to those due to dead and live load and temperature. These effects were computed under maximum load, including the factor of safety so as to anticipate and include the secondary stresses occurring at the critical load.

Flexibility advantageous

The structure as a whole was intentionally kept somewhat flexible. Comparative studies showed that a light flexible roof structure supported by relatively heavy rigid frames was more advantageous than a heavier and more uniform framing. Increasing the stiffness of the dome was found to act largely to increase the weight and design difficulties in the main frame and to attract increased moments into the dome structure without increasing the factor of safety. The short-time live-load deflections at the center of the dome under the most critical distribution of loads, and using a modulus of elasticity of the concrete of 3,000,000 psi, were computed as 5 in. upward and 3 in. downward or 1/720th and 1/1,200th respectively of the span. This live-load deflection is relatively smaller than that permitted in long-span bridges and other major structures.

Long-time dead-load deflections due to creep in the concrete in combination with short-time live-load deflections were computed as 8 in. downward, using a reduced E of 750,000 psi for the concrete in determining the dead-load deflections. While the effective stiffness of the concrete under long-time load was considered to be only one quarter of that expected for short-time loading, sufficient compres-

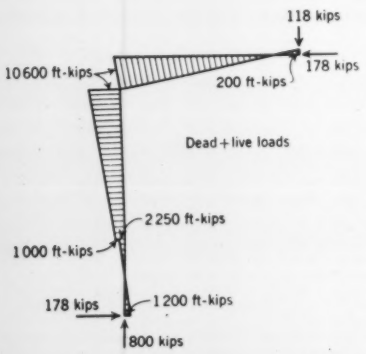


FIG. 3. Moment diagram for typical bent.

sion steel was needed by the pattern loading effects to prevent a decrease in effective stiffness of more than 25 percent.

Each section of the dome, the cantiliver, and the bent legs was proportioned and reinforced for the most critical of the ultimate loadings obtained by either of the following two equations:

$2 \times$ (dead load + live load + ½ wind load) + ¾ secondary moments + volumetric change) . (1)

$1.2 \times$ (dead load + ½ wind load + volumetric change + secondary moments + 2 live load) . . . . (2)

The moment diagram in Fig. 3 is a typical example of the moments in the bent, the moments in this case caused by the particular loading of dead load + full live load over the entire roof structure. The moments shown in this diagram were the most severe of all the vertical loadings for the inside of the bent at the first-floor level and for the outside of the bent and cantilever at the top of the side wall. At all other points the moments and reversal of stress were governed by partial live loadings.

The building is founded on concrete caissons embedded in the rock stratum. Such caissons are commonly used in the Texas area. Most columns are supported by a single caisson except for the main roof bents, which are each supported by a bank of 5 battered caissons, of which the two 30-in. caissons are battered radially in one direction and the three 24-in. caissons are battered radially in the opposite direction. All caissons supporting bents are reinforced for tension forces.

Stone aggregate concrete was used for the structure below the cantilever arms. The cantilever arms, the entire dome, and the shell between the cantilever arms was formed using high early cement, an air-entraining agent, an admixture, and a lightweight expanded shale aggregate. All concrete except for slabs on grade is 3,750-psi at 28 days. Decentering of the roof sections was permitted at a cylinder strength of 2,000 psi and a minimum modulus of rupture of 2,000,000 psi, whichever was achieved last.

The planning, design, and field supervision of the Dallas Civic Center was performed by Architect George L. Dahl of Dallas. Ammann and Whitney of New York furnished the structural plans and consultant construction supervision for the auditorium part of the project. The general contractor for construction is R. P. Farnsworth & Co., Inc., of New Orleans, La.

Traveling dome forms reduce construction cost

H. P. FARNSWORTH, Jr., and GEORGE J. SULLIVAN

Respectively Vice President and Project Engineer, R. P. Farnsworth & Company, Inc., New Orleans, La.

High traveling forms in narrow segments were the key to economic construction of the domed Dallas Memorial Auditorium. Taking full advantage of the segmental design, R. P. Farnsworth & Co., Inc., estimated the job on the basis of forms for only one-eighth of the 204-ft-dia dome and supporting cantilevers, as described in the preceding article. The outstanding construction feature was the traveling forms 90 ft high, fitting into a central dome cap of 22-ft diameter, temporarily supported on an oil-derrick frame.

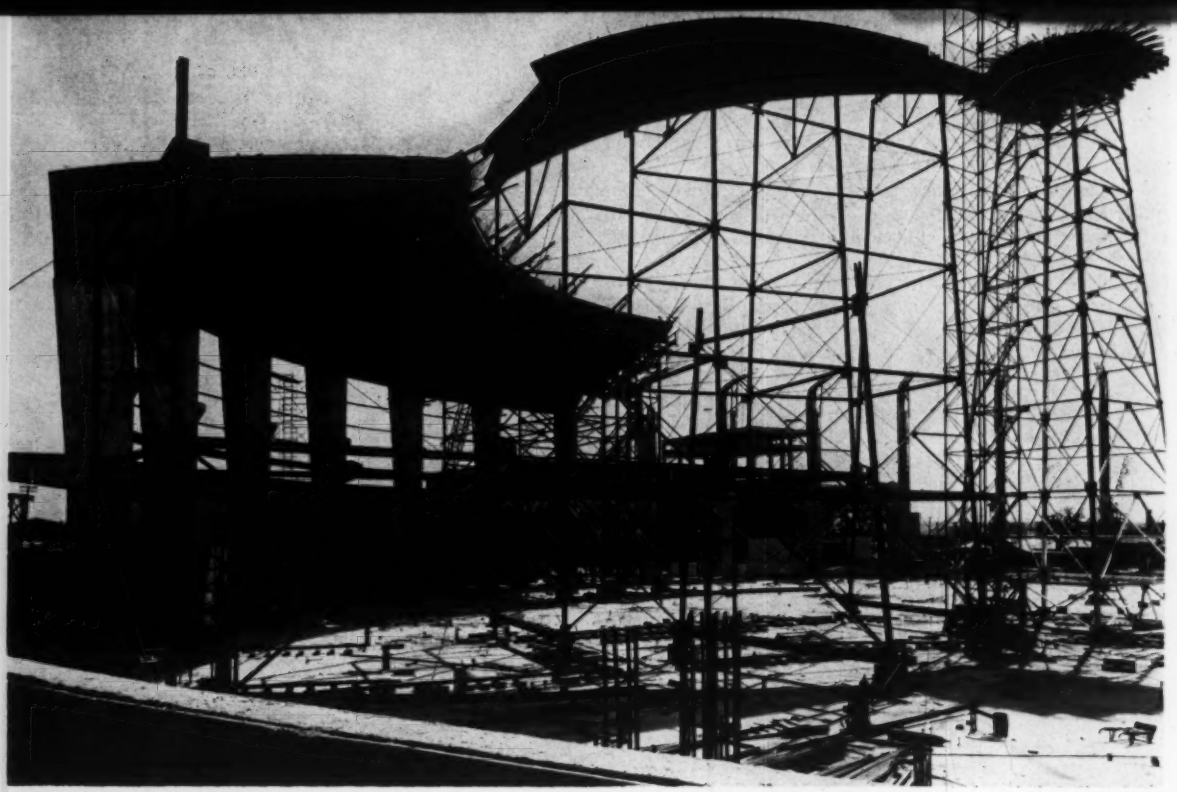
In comparison with the conventional procedure of forming the entire dome at one time, the use of traveling forms and falsework for opposing units of the 16 pie-shaped segments gave potentially great economies. But realizing these economies required detailed planning, careful fabrication, and rigid adherence to a tight schedule for moving, setting, and filling the concrete forms.

The entire structure rests on concrete caissons. These were constructed by auger drilling through 8 to 35 ft of clay, 1 ft of calcium rock, and 6 in. into the blue bedrock. A reinforcing cage was lowered to the rock surface and the entire hole filled with concrete.

The main floor of the arena was constructed ahead of the basement, which lies directly on the ground, to expedite use of the traveling forms for cantilevers and dome. The floor is a flat slab supported on circular concrete columns with flared tops. This flat concrete disk is about 300 ft in diameter and varies in depth from 8½ to 12½ in. Formwork for the first floor was built of standard ¾-in. plywood deck, 4×4 joists, and 4×6 wood beams. It was supported by 4×4 shores 17 ft long, set on 2×12 mud sills and laterally braced at two levels.

The real job problems began with the erection of the 32 vertical bents. Special forms, designed by Dixie Form and Steel Co., were used for the concrete columns, which are 7 ft 0 in. by 2 ft 6 in. in cross section at the bottom. (See Fig. 1 of the preceding article.) The forms were fabricated using $\frac{3}{16}$-in. steel plate supported by structural steel channel wales. Forms were made in three sections to accommodate the varying shapes of the bents. The first section extended up to the level of the first-floor beam. This was a basic form except that the 2-ft 6-in. sides were left open to provide for doweled construction joints where ramp beams were tied in at varying elevations. A center section formed the 25-ft cantilever support for the outside canopy roof; shoring remained in place until the dome cantilever was released. The vertical portion of the center section extended 31 ft 4 in. above the first-floor slab and had reinforcing extending an added 32 ft above the pour.

Since the placing of the reinforcing steel had to be exact, sections of vertical bars were fabricated on the ground and then guyed into position before the forms were placed. Anchor bolts for structural connections to the bents had to be placed during the ground fabrication of the reinforcing. After fabri-



Outstanding construction feature of 204-ft-dia dome is traveling form for pie-shaped segment. Stock oil-well derrick carries form for center cap of 22-ft diameter. Tubular tower handles material to top of structure.

cation the reinforcing was rigid enough to be erected by a crane, and the crane had to hold it in position until the butt-welded splices were made and the guys securely anchored, making the reinforcing steel a self-supporting member.

At a height of 30 ft 10 in. above the first floor, the upper portion of every other leg was split, the 2-ft 6-in. width being placed in two 1-ft 2½-in. sections. This separated the 300-ft-dia circle into 16 cantilever frames and formed the basic pie-shaped segment of the roof dome. Forming the 1-in. width between these segments presented a particularly tough problem. The method finally developed was to use two steel plates separated with tempered steel rods, graduated from ⅜ in. in diameter at the bottom to ⅞ in. at the top, making a narrow wedge-shaped split and dividing the bent legs. The rods were removed by a special screw jack, and the form plates were lifted out with a large crane.

Forms for the cantilever frames as well as for the dome ribs were manufactured by the Dixie Form and Steel Company. Each cantilever form consisted of two separate traveling units. When bolted in position, these units formed two split cantilever ribs on the edges of the form, with one full cantilever rib in the center. The cantilever form had a contact area of 4,465 sq ft and supported 128 cu yd of concrete at a height of 65 ft above the first-floor level. Wheel loads up to 72,000 lb had to be transmitted to the columns to prevent damage to the first-floor concrete slab.

In many cases the traveler legs were required to be over ramp wells. At these locations a wood trestle was used with four 8 × 8 columns mounted on skids for ease in moving from one location to another. Because of the depth of the cantilever ribs and their convergence toward the center of the building, the cantilever traveler had to move downward 8 ft to obtain clearance so that it could travel in toward the center of the building. The form was then moved inward 13 ft, switched to peripheral rails, and rolled to its new position.

The cantilever form was so designed that all beam side-plates could be unbolted and released while the roof deck and cantilever soffits were still supported. After decentering, the form was lowered 4 in., using screw jacks. The jacks were then removed, transferring the form weight to a hydraulic system that lowered the forms until the needed clearance was obtained. Form crews worked a full day unbolting and preparing to move the form. An additional day was required for decentering and traveling to the new position. The split cantilever ribs, like the split bents, were separated by tempered smooth steel rods and steel plates.

Support of the circular dome cap was a major problem. Ultimately this section would have to carry the entire load of the dome until all segments were concreted and the center support removed. It was planned to place opposing sections in careful sequence but there was a possibility that a large thrust reaction might be transmitted to the center support by varying weather conditions or the hanging of structural steel under the cantilevered bents.

Project Engineer Joe Sullivan designed a center support 90 ft high that would withstand anticipated vertical and horizontal loads, and provide a controlled lowering mechanism for later decentering. The tower design resembled an oil derrick so closely that a prefabricated unit of this type was indicated. A rig normally used for offshore drilling was found that would withstand all the anticipated wind, thrust, and vertical loads.

The derrick was erected in the middle of the arena floor and crowned with a sand jack system made up of four such jacks. Concrete was then placed in the 22-ft-dia dome cap with dowels extending radially, in readiness for the arch ribs of the dome.

Truck crane operating on main floor places ring of structural steel for mechanical and press rooms, hung from dome framing above arena.

After the cap was cast, the dome traveler forms were erected. Here again, the tremendous clear span and height made a steel rolling form the only practical approach to the job. This form was constructed in two opposing sections, each standing on four legs and carrying loads, including concrete, of 75,000 lb per leg.

Movement of this form at the time of decentering had to be uniform in each direction to maintain equal forces on the opposing cantilevers. An eight-point system of manually operated screw jacks was installed on each of the opposing forms. The screw jacks were used to peel the form slowly from the concrete simultaneously on opposite sides. After clearing the concrete above, the forms were lowered a foot to clear the arch ribs. Four hand-operated winches pulled the forms to their new location. The hand winches allowed slow movement and gave exact control, as this top-heavy load demanded maximum caution.

A standard tubular tower hoist, with auxiliary boom, was used to elevate materials, including reinforcing. From this tower, dome concrete was loaded into Georgia buggies and transported to placing points.

When the dome was three-quarters complete, erection of structural steel for the upper ring was started. Farnsworth's engineer designed a special shoring system under the arena floor to support a ¾-cu yd truck crane, which was used in hanging the structural steel. To erect the floor steel, a steel crow's-nest type of platform was connected to the cathead of the crane's jib boom so that the workmen could make structural connections directly under the dome and cantilever ribs. The upper ring of structural steel forms a continuous floor system housing the mechanical and press rooms. It is suspended from the dome and cantilever ribs at a height of 52 ft above the arena floor.

Before the upper structural-steel ring was fully completed, the dome was decentered. The decentering was accomplished by removing one quart of sand simultaneously from each of the four sand jacks, which by volume lowered the dome cap ⅛ in. Removal of sand was accomplished by a gate valve in the center of each jack. After one quart of sand had been removed from each jack, all gate valves were closed and the jack cylinders were tapped with a hammer until a vertical movement of ⅛ in. could be measured. This operation was repeated 28 times over a period of 6 hours before the first sign of the jacks' clearing the dome cap could be seen. The total vertical movement on the day of decentering was 3⅜ in.

After the dome forms were removed from the arena floor, a circular traveler carrying wood forms was moved in for second-floor placement. The loge and balcony were erected by wood traveling forms. Because of the structural design, loge sections were poured before balcony sections (Fig. 1). The loge and balcony slab soffit was formed in the shape of an inverted cone.

The biggest single problem on this project was coordination. The design of the building was such that the work had to be done in definite sequence. In conventional construction, very often one operation can precede another, but on the Dallas Memorial Auditorium, every operation had to be completed before the next could proceed. Each operation had to fit into its prearranged place like the pieces of a giant jig-saw puzzle.

Work for R. P. Farnsworth & Co. was directed by Philip Vortisch, Superintendent, and Joe Sullivan, Project Engineer. Another important man for Farnsworth was Oscar Porter, Company Superintendent. Bob Lackland was Chief Engineer.

George L. Dahl, the Architect, was represented in the field by J. T. Ratcliff and Dave Walker.

The structural design for the main auditorium was by Ammann & Whitney of New York, N. Y.

The Greek Architekton—Part 1

J. K. FINCH, M. ASCE
Dean Emeritus and Renwick Professor of Civil Engineering, Columbia University, New York, N. Y.

A new people, the Greeks, building on earlier advances coming to them from Egypt and Mesopotamia, developed a new way of life which marked the real birth of Western as contrasted with earlier Eastern civilization. Thus, while our ancestors in Europe were still in the Stone Age, the long centuries of oriental supremacy were giving place, beginning about 600 B.C., to the brilliant leadership of a new people whose ideas, interests, and activities set a pattern for later European culture. The engineer of today quickly recognizes in his Greek prototype a fellow worker of like aims, viewpoint, and methods, and can easily understand why the Greeks are often referred to as "the first of the moderns."

These newcomers on the stage of civilization are believed to have been a group of Indo-European tribesmen who, driving their herds before them and transporting their families in rough carts, were drifting from the East into the Greek peninsula as early as 2000 B.C. Here they came in contact with the outposts of the oriental culture of the period. The new West met the old East. During the next thousand years they were absorbing the essentials of civilized life and preparing to add their own remarkable contributions to Western progress.

Even in the dawn of civilization, 3000 B.C., an early people known as Aegeans had established outposts of oriental culture in the eastern Mediterranean. On the island of Crete they had early learned bronze and pottery making from their neighbors the Egyptians. In their great age, around 1500 B.C., they built remarkable palaces such as that at Cnossus, in which the first reasonably adequate systems of sanitary drains were installed. In art they also reached new levels. At the same time other settlements on the mainland of Greece to the north, Tiryns and Mycenae near Athens, and the many times rebuilt city of Troy near the Bosphorus, also became parts of the bridge between the old and the new. Likewise the ships of the seafaring Phoenicians brought to the Greeks many products from the East, including the iron of the Hittites, and perhaps the most valuable import of all—the Phoenician alphabet. By 600 B.C. oriental leadership had declined, and it was the new Greek way of life and thought that was becoming dominant in the eastern Mediterranean.

The engineer in Greek life

Our picture of ancient Greece has been so colored by the idealistic classical viewpoint that even the idea of the Greek as an engineer seems almost sacrilegious. The great debt we owe Greece for her contributions to economic life, to engineering progress, to building and the practical arts, industry and commerce, has long been overshadowed by the praise that has been lavished on her remarkable contributions in the domain of literature, art, and philosophy. Indeed the great Greek thinkers themselves, from Plato to Archimedes, stressed the viewpoint that any application of the fruits of the mind to material needs was, if not actually debasing, at least unworthy of the serious consideration of free men.

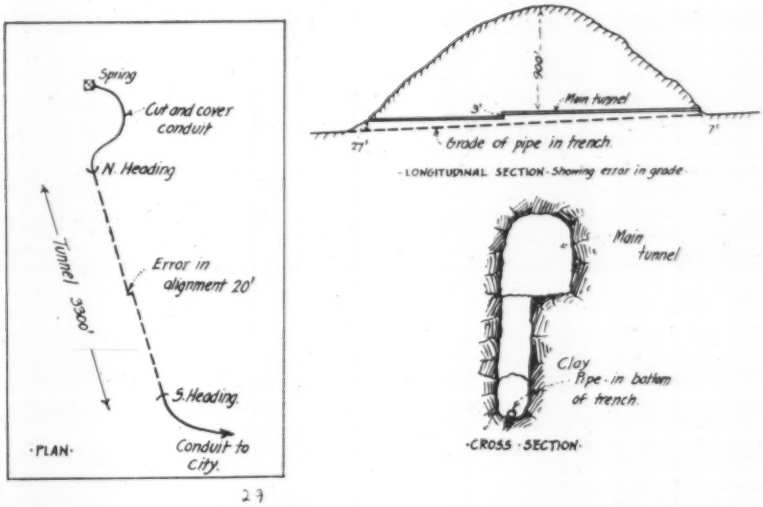
For centuries this narrow, unrealistic, and unprogressive attitude colored western thought. Together with later shackling religious beliefs, it retarded the development of natural science, the foundations of which were also laid in ancient Greece. Fortunately what Lord Macaulay characterized as the "unprofitable" character of Greek thought had little or no effect on her remarkably profitable contributions to technical progress. The Greeks may in truth be said to have established the foundations of modern engineering.

It is obvious that until man has met his major material needs, little time will be available for what are called the higher things of life. Early man was clearly the slave of his environment, and no matter how civilized man may become, his material welfare still forms the foundation on which the higher creations of his mind are erected. A thriving economy based on trade, commerce, and colonization was fundamental to Greek life, and it survived the bloody strife and economic losses of the century of turmoil that followed her Golden Age—the Age of Pericles.

In politics also Greek life offered some notable contrasts with the Orient. There were stirrings of democracy. Greek leaders held their posts largely at the will of the citizens. These were not, to be sure, the majority of the people. It is estimated, for example, that by the time of Pericles, circa 430 B.C., the population of Athens had reached perhaps 315,000 but of this number only 43,000 were citizens. Besides the women, who had no vote, there were some 28,500 metics, or resident aliens, and some 115,000 slaves.

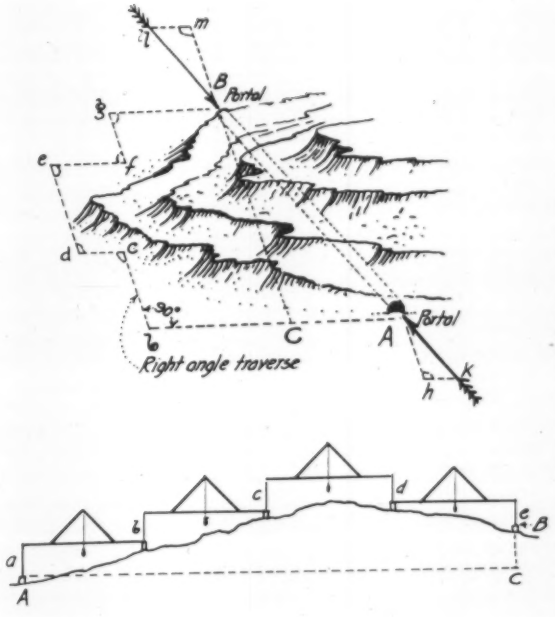
While the slaves undoubtedly carried out most of the manual labor of the farms and of the early industries and construction projects, it is manifestly an error to argue that "technical invention (and progress) was possible only to those (that is, slaves) who had no interest in it." That the men who directed such laborers were not only in close contact with the practical problems involved, constantly learning through first-hand

Initial design shows, at left, the dioptra *or right-angle sighting device with water-level attachment described by Hero of Alexandria at beginning of Christian Era. Although it was the prototype of the modern surveyor's transit, this instrument was probably not as generally used as the simpler Roman* groma, *illustrated directly above initial at right.*



27

Tunnel of Samos, completed about 500 B.C., is seen in plan and section. Note errors in grade and alignment.



Two early methods of tunnel surveying are illustrated. Upper figure shows alignment survey by method first described by Hero around 50 A.D. but probably in use long before his day. Lower figure shows leveling with ancient triangular frame and plummet. Similar measurements were undoubtedly made by Eupalinus for tunnel at Samos about 500 B.C.

observation and experience, but were also acquainted with the basic advances of the day in the areas of mathematics and mechanics, is amply demonstrated in their works. Engineering was a vital instrument of Greek life. In fact the Greeks coined a new title for the master builder. He became known as *architekton*, that is, archtechnician, a master of the practical arts, the *tektonia*. While this is the origin of our word architect, the Greek *architekton* was a true master builder, an all-round construction expert.

It would be natural to expect some specialization. Those who erected the great public buildings, the temples and theaters, which were works of art as well as notable structures, may well have been held in somewhat higher esteem than, say, Crates of Chalsis, who was described as a mining and tunneling expert. Centuries later, apparently about 500 A.D., after the fall of Rome, in the Eastern Roman Empire centering in Constantinople, the title *mekanikos*, or mechanician, appears. This has been translated as engineer, but that the men in question were architects as well as engineers is supported by the fact that even today no distinction is made in Greece between these two professions. Both groups are still known simply as *mechanicoi*. The civil engineer, however, is called *politicos mechanicos*, and the electrical engineer is *electrologos mechanicos*. The ancient title *architekton* is again coming into use but with its modern, limited meaning.

In earlier days, as has been noted, the practice of the master builder involved no complicated techniques of planning and design, no highly specialized knowledge not easily grasped by a competent and able head of state. The basic ability was that of commanding and organizing human labor. With the development of the Greek way of life, however, a great step forward was taken in technical understanding and procedure.

The Greeks, building on their heritage from earlier ages, developed surveying, construction, mechanical and other specialized technical practices that marked the advent of a new era in the life of the master builder. Herodotus, known as the first historian (c. 450 B.C.), might still attribute earlier structures to kings and gods, but he also recognized the *architekton* as intermediate between the initiator of works and the foreman of manual labor —as a technical expert and a skilled planner and director of such activities.

To what extent formal education was involved in developing this new specialized competence is unknown. Vitruvius, the Roman master builder of about the beginning of the Christian Era, whose treatise has come down to us, says it was the practice of the Greeks "to entrust their work in the first place to master builders of good family and next to inquire whether they had been properly educated . . . and the master builders themselves would teach none but their own sons or kinsmen, and trained them to be good men."

Pappus of Alexandria (c. 320 A.D.) notes that Hero's followers divided mechanics into a theoretical part which included geometry, arithmetic, astronomy, and physics, and a manual part which covered work in metals, construction, carpentering and painting. He notes that "the man who was trained in his youth in the aforesaid sciences as well as practiced in the aforesaid arts and has a versatile mind is the best inventor of mechanical devices and builder."

Some knowledge of arithmetic, geometry, and mechanics was obviously essential, but apprenticeship undoubt-

edly was the major avenue to professional competence, as it continued to be until very recent times in all professions. Thus it can be said that while our forerunner, the Greek master builder, was no longer a noble of the court as he had been in ancient Egypt, or identified with kingship as appears often to have been the case in Mesopotamia, yet he had achieved the first notable advance toward truly professional stature. His activities demanded a specialized knowledge and experience which were generally beyond the scope of his fellow citizens.

Topography and politics

As in Egypt and Mesopotamia, both topography and the ups and downs of political and economic life exerted a major influence on Greek engineering work. The Greek peninsula has been likened to a long hand stretching out into the eastern Mediterranean. Between its rocky ridges were fertile valleys where agriculture flourished and towns developed to become the heart of city-states. This rugged topography discouraged efforts to provide for communication by roads, and the Greeks turned to the sea to become the first great harbor builders. Town life emphasized the need for city planning, water supplies, and other public works. Thus a new chapter was written in this field.

Another and less fortunate result of the topographic isolation of the Greek city-states and the lack of easy means of communication among them, was probably the fatal inability of the Greeks to join forces among themselves and build a strong nation—a failure which led to their downfall. Neither their struggles with the Persians nor among themselves taught them the valuable lesson of cooperation. The country became so weakened by strife that shortly after 200 B.C. it fell quietly into the hands of the Romans, the next nation to take up the torch of Western civilization.

Notable Greek engineering works date back at least to the sixth century B.C. After early experience with kings, followed by the rise of a group of nobles who built their wealth on expanding trade and commerce, came the so-called Age of Tyrants and then the achievement of a more democratic form of government. The Persian threat was ended by the Greek triumph at Salamis in 480 B.C., the first great naval battle in the history of the world. There followed the Age of Pericles, a great era of public works in Athens, which soon came to an end with the struggles of Athens with her southern neighbor, Sparta. This struggle brought the Athenian empire to a close in 404 B.C. In 371 B.C., Sparta gave way to Thebes, and all Greece fell an easy prey to Philip of Macedonia. His son Alexander the Great (356-323 B.C.) became the conqueror of the Near Eastern world.

In the two or three centuries that followed Alexander's conquests, called the Hellenistic Age, leadership again turned eastward. Alexandria, on the Nile delta, became the center of progress and enlightenment and did not fall into Roman hands until almost the dawn of the Christian Era. In each of these major periods of Greek life, important advances were made in technical understanding and competence.

Eupalinus of Megara and the Tunnel of Samos

In his famous history of the world of his day, Herodotus apologizes for the space he devotes to Samos, one of the easternmost of the many Greek islands of the eastern Mediterranean. He goes on to explain that the Samians had constructed the three greatest of Greek works—a tunnel, a harbor, and a temple. He names the *architekton* of the tunnel, the earliest known use of this title, as Eupalinus of Megara, whose professional abilities apparently led to his being called from his home near Athens to undertake the work.

The admiration expressed by the Father of History for the courage, skill and daring of this pioneer tunnel expert is readily understood when it is realized that Eupalinus undertook and succeeded in completing a tunnel some 3,300 ft long through solid limestone, by the laborious hand-chiseling methods of the day. It was tunneled from two headings starting on each side of a mountain which Herodotus notes was some 900 ft high.

In an earlier but similar Hebrew work circa 700 B.C., designed to bring the spring water of Gion into Jerusalem, the two headings had met only after many futile attempts of the excavators to "find" each other and join them. The result was a work 1,750 ft long—plus many false starts—as compared with the straight-line distance of 1,100 ft. (See *Explorations in Bible Lands*. by H. V. Hilprecht, Holman, Philadelphia, 1903, p. 613.) Even in later Roman times there is an amusing record of like difficulties on a similar undertaking in North Africa. In fact it appears that this problem of tunnel alignment was avoided whenever possible both by the Greeks and by the Romans through the use of many intermediate shafts even when these had to be very deep.

Eupalinus's basic problem was of course surveying—how to so direct the two headings as to line and slope—it was a "grade tunnel"—that they would meet. Actually errors occurred in both line and grade but the workers apparently could hear one another and joined the headings by a cross-cut some 20 ft long. When they met, the floor of the north heading was found to be some 3 ft above that of the south heading. To correct this error in grade and probably to provide a greater slope for the water conduit, a side channel was cut, varying in depth from 7 to to 27 ft. In the bottom of this side channel, the small clay water pipe only 7½ in. in diameter, was laid in lengths of about 2 ft. The tremendous amount of excavation made for such a small conduit is however exceptional. In other Greek water supplies, the pipes vary from 4 to 8 in. in diameter, and the tunnels are often so small that we wonder how the diggers could ever have wriggled into and out of these "rabbit burrows," as the Romans called them.

As far as survey methods are concerned, the records are silent. Where topography permitted, it would be possible to "range in" a line from portal to portal and measure and level over it directly. It seems more probable, however, that Eupalinus took advantage of a plan that permits the measurements to be made over the most favorable intervening terrain, shown in an accompanying illustration. Although this method is first described by Hero of Alexandria some five or six centuries later, there is no reason to suppose that it was not available to Eupalinus.

As for the basic measurements, ropes or measuring rods would have served for distances. And for the setting off of right angles, several devices were available, not only the early 3-4-5 triangle but probably a forerunner of the Roman *groma* or surveyor's cross, or even Hero's *dioptra*. There was also the ancient leveling A-frame or "water level."

The square law was probably known even before it was demonstrated by Pythagoras, who lived about 582-500 B.C. Thus the simple additions and subtractions of the direct length measurements of a right-angled traverse would have given the two sides of the right triangle of which the tunnel was the hypotenuse. Similar triangles set off at each portal would have provided the direction for the headings. Here we find a plan still basic today in tunnel surveying.

(Additional informative material on Greek engineers and engineering will appear in subsequent articles by Dean Finch.)

THE READERS WRITE

Need for Building Construction Division questioned

To the Editor: Your February issue (p. 64) carried a letter to the editor from Prof. Werner H. Gumpertz, of Massachusetts Institute of Technology, who proposes—if there is sufficient interest—the formation of a new Technical Division in ASCE, a Building Constructive Division. His main motive appears to be twofold:

1. Such a Division would stimulate a construction industry curriculum in universities and facilitate accreditation by the Engineers Council for Professional Development.
2. Such a Division would hasten the adoption by the building construction industry of "advances in technology and management."

I question seriously whether we have need for a Building Construction Division in ASCE. We already have a Construction Division and a Structural Division. Universities will offer a construction curriculum (some already have) when the demand is sufficiently great; I doubt whether ASCE would have much influence in shaping a university's plans in this direction. With respect to the second objective, I would be surprised if the Construction Division is not already quite conscious of advances in technology and management, and fostering and publicizing means of taking advantage of such developments.

The Structural Division, anxious not to overlook its responsibilities in the building field, has recently appointed a committee to ascertain in what way—and by what means—it can better serve those whose primary interest lies in this field. The committee is even at this moment collating its information. The members of that committee are: A. George Mallis, Springfield, Mass., chairman; Samuel Judd, Denver, Colo.; Charles G. Marchant, West Hartford, Conn.; Roy Gunnar Johnston, Los Angeles, Calif.; Grayson W. Gill, Dallas, Tex.; and A. L. Miller, Seattle, Wash. I am sure this committee would welcome comments from ASCE members.

Warren Raeder, M. ASCE
Head, Dept. of Civil Eng., Univ. of Colorado, and Chairman, Exec. Committee, Structural Division

Denver, Colo.

Engineering talent is sold too cheaply

To the Editor: The article in the February issue, "Viewpoint of an Employer in a Private Organization," by J. D. Carpenter, M. ASCE, subtly reveals a common characteristic of engineers. Engineers are deficient in the art of selling their professional services for what those services are worth.

I would place the "blame" for this phenomenon with the colleges of engineering. The professional staffs of many engineering colleges are composed of engineers who are dedicated to training other engineers. They generally accept a low salary for their tireless services, knowing they are really making the world a better place to live in because of the impending contributions of their students. The students learn engineering economy, realizing that their future worth will depend on their ability to design great structures at minimum cost. Engineering students study hard, having been taught that there is no substitute for knowing-what-one-is-doing-at-all-times. On graduation, the young engineers are hired at a respectable starting salary because there is a "shortage"; not enough people have trained themselves to accept a lifetime of low pay.

Then the bubble breaks. Within two years these engineers look about and realize that their chances of getting justifiable and substantial raises are slim. They do not have the personality traits to sell their professional talents, and their colleagues are carbon copies. They watch the ex-college playboy, the man who has an average academic background in an abstract science but who has developed poise and presence, soar high on the salary scale. The engineers sell their talents cheaply, rationalizing the situation by considering themselves a sacrifice to *engineering economy*, in line with their training and thinking.

There are many exceptions to this picture but the basic truths cannot be denied. I don't know the whole answer to the dilemma, but believe that collective bargaining is not it.

If and when engineering colleges add a fifth year to their curricula, the extra time made available should be spent in classes of speech, debate, dramatics, athletics, literature, and other social skills. These classes would prepare the engineer to attain the professional standing that he now admires. Professional standing may truly be defined as a mixture of self-respect and skill which generates and commands the respect of other people. Furthermore, power of speech and a knowledge of human nature would enable him to better sell desirable engineered products to a competitive world.

At least he could sell himself for a salary raise commensurate with his abilities.

Elmer L. Christiansen, J.M. ASCE
Assoc. Civil Engr., Los Angeles County Flood Control Dist.

Los Angeles, Calif.

Engineering students need adequate preparation

To the Editor: To clear up a point raised by K. S. Anderson, M. ASCE, in his letter in the March issue (p. 66), may I say that it is not my aim to add an extra year on the engineering curricula in order to cover neglected high school subjects. If the proposed three-year professional engineering curricula required a two-year pre-engineering program in arts colleges, including chemistry, physics, and two years of college mathematics, and the high school student did not have the necessary high school algebra and physics, then he would have to spend at least part of an *additional* year in preparation. The advantage would be an incentive for serious students to prepare to meet the fixed requirements.

Mr. Anderson is correct in stressing the need for political science, history, geography, economics and other subjects to make the engineer also a citizen, and to round out his background for future development. Adequate coverage of these subjects cannot now be squeezed into four years and still do justice to the necessary mathematics, sciences, and engineering subjects. Some could well be placed in the two-year pre-engineering program and the rest interspersed in the professional curriculum. Faster progress can be expected with a class

that comes selected after two years of college experience.

Incidentally we may be wasting our time in attempting to force the high schools to adjust their courses upward for engineering. It looks as though the colleges will have to provide more "refresher" subjects to accommodate the vast numbers of poorly prepared incoming freshmen who have met the lowered standards in high school but are not yet ready to begin their engineering education. This preparatory work does not belong in a professional school. It should be offered in community colleges.

S. B. Folk, M. ASCE
Prof. of Eng. Mechanics
The Ohio State Univ.

Columbus, Ohio

Deflection factors for simple beams

To the Editor: I have read with interest the article on beam moment of inertia and deflection by John Webster Brown in the December 1956 issue, and also the comments on it in the March 1957 issue (p. 67).

I have been using a table I drew up several years ago giving similar information in a slightly different form. This table, the accompanying Table I, is I believe self-explanatory and is offered in the hope that others may find it as useful as I have. In designing for a limiting deflection, I think most engineers would prefer to test their own judgment by selecting a beam section and then checking the deflection. After one or two misses in early practice, the designer establishes a feeling which is not gained by the possibly shorter method of calculating the necessary value of I beforehand.

Table I can however be used to determine the value of I required by equating the maximum allowable deflection to the appropriate value of $F\,(w/I)$ or $F\,(W/I)$. It will be realized that $\frac{l}{360}$, in inches, is simply $\frac{\text{Span in ft}}{30}$, and $\frac{l}{240}$ is $\frac{\text{Span in ft}}{20}$, operations that can be done mentally and do not require tabulation.

TABLE I. Deflection factors for simple beams

Uniform Load lb per ft $F\,(w/I)$	Span, ft	Concentrated Load at Center, kips, $F\,(W/I)$	Uniform Load, lb per ft $F\,(w/I)$	Span, ft	Concentrated Load at Center kips, $F\,(W/I)$
0.0077	10	1.24	0.715	31	37.0
0.0113	11	1.65	0.816	32	40.7
0.0161	12	2.15	0.918	33	44.6
0.0222	13	2.73	0.932	34	48.8
0.0300	14	3.41	1.162	35	53.2
0.0393	15	4.19	1.302	36	58.0
0.0508	16	5.09	1.450	37	62.9
0.0647	17	6.10	1.619	38	68.1
0.0810	18	7.25	1.800	39	73.5
0.1000	19	8.50	1.985	40	79.4
0.124	20	9.94	2.118	41	85.5
0.151	21	11.50	2.415	42	92.0
0.181	22	13.20	2.650	43	98.7
0.218	23	15.10	2.908	44	105.9
0.259	24	17.20	3.180	45	113.2
0.303	25	19.40	3.475	46	120.5
0.354	26	21.80	3.780	47	128.5
0.412	27	24.40	4.115	48	137.0
0.459	28	26.20	4.468	49	145.7
0.549	29	30.30	4.850	50	155.0
0.629	30	33.50			

The notation is:

Δ = deflection, in. = $F\,(w/I)$ or $F\,(W/I)$
L = span, ft
w = uniform load, lb per lin ft
W = concentrated load at center of span, kips
$E = (29 \times 10^6)$ psi
I = moment of inertia, in.^{4}

Example 1: Find the deflection in the center of a 22-ft span for a uniform load of 1,200 lb per ft using 16 WF 36 (I = 446.3 in.^{4}). From Table I, the uniform load factor for this span is 0.181. Substituting,

$$\Delta = \frac{0.181 \times 1{,}200}{I} = \frac{217.2}{446.3} = 0.49 \text{ in.}$$

Example 2: Find the deflection in the center of a 20-ft span for a concentrated load of 15 kips in the center of the span, using 16 WF 36 as before. From Table I, the load factor for this span is 9.94. Substituting,

$$\Delta = \frac{9.94 \times 15}{I} = \frac{149.1}{446.3} = 0.33 \text{ in.}$$

The above examples are for steel beams. For wood beams (where $E = 1.2 \times 10^6$), use Δ as obtained from the tables, multiplied by 24. For wood beams (where $E = 1.6 \times 10^6$), use Δ as obtained from the tables, multiplied by 18. For concrete beams (where $E = 3 \times 10^6$), use Δ as obtained from the tables, multiplied by 10, approximately.

It is not my intention to detract from the value of Mr. Brown's original article. He will realize, I hope, that the comment it has provoked is in itself a demonstration of its worth.

I. T. C. Larnder, A.M. ASCE
Structural Engineer

Montreal, Canada

Simple formula solves for beam moments

To the Editor: In reference to the article, "Beam Moment of Inertia Determined by Table," in the December 1956 issue (p. 68), I would like to offer the following comments. Tables such as that presented by Mr. Brown can be very useful and time saving tools. However, when the computations involved can be reduced to a simple, easily remembered formula ($I = 0.3\ Sl$) I believe this is a further simplification.

As the usual procedure is to proceed from the determination of the moment M to determining the required section S, a method was sought to carry this one step further and obtain the required moment of inertia from the previously determined section modulus. Beginning with the formulas basic to this problem, this was done as follows:

Given: $M = \frac{wl^2}{8}$; $S = \frac{M}{f}$; $I = \frac{5\,wl^4}{384\ Ed}$; $d = \frac{l}{360}$

Required: A solution for I in terms of S and l.

Solutions: $S = \frac{M}{f} = \frac{wl^2}{8f}$

$$I = \frac{5\,wl^4}{384\,Ed} = \frac{wl^2}{8f} \times l \times \frac{5 \times l \times 8 \times f}{384\,E \times l/360}$$

$$I = SL \times \frac{5 \times 8 \times 360\,f}{384 \times E}$$

Substituting for f and E and multiplying by 12 in. per ft in order to adapt the formula for the initial substitution of l in feet in the final form,

$$I = SL \times \frac{5 \times 8 \times 360 \times 20{,}000 \times 12}{384 \times 30 \times 10^6}$$

$$I = 0.3\ Sl$$

where I is in in.^{4}, S in in.^{3}, and l in ft.

Incidental to this, by substituting for f and converting to practical units, the formula for the section modulus can be written in the form,

$S = 0.6\ M$, where S is in in.^{3} and M in ft-kips The three basic equations can now be expressed in what is believed to be their most practical forms:

$$M = \frac{wl^2}{8};\ S = 0.6\ M;\ I = 0.3\ Sl$$

where M is in ft-kips, w in kips, l in ft, S in in.^{3}, and I in in.^{4}

For example, to solve the problem given in the article:

Given: l = 17.5 ft; w = 1.35 kips per ft; and d limited to $l/360$.

Solution: $M = \frac{(17.5)^2 \times 1.35}{8} = 51.7$ ft-kips

Required $S = 0.6 \times 51.7 = 31.1$ in.^{3}

Required $I = 0.3 \times 31.1 \times 17.5 = 163$ in.^{4}

By simple proportion, the formula $I = 3\ Sl$ can be adapted to other conditions, such as when the deflection is limited to $l/240$. The formula then becomes

$$I = 0.3\ Sl \times \frac{240}{360}, \text{ or } I = 0.2\ Sl.$$

It is also merely a matter of simple proportion to determine the actual deflection of the beam selected.

$$d_{\text{actual}} = \frac{l}{360} \times \frac{I \text{ required}}{I \text{ furnished}}$$

I have used this formula for many years and believe it to be the simplest and quickest method of determining I or d.

Rolf C. Rosenvinge
LTJG CEC USNR

New York, N. Y.

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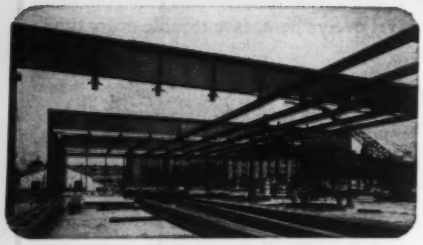

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The vast roof is suspended from **6′-deep plate** girders, which project out of the building as an exterior skeleton. These girders were shop-fabricated, and each was delivered to the building site in two 60-ft. sections. There, they were spliced and hoisted into place. Purlins are hung beneath the roofing.

This huge, open hall, which could be used for virtually anything from a factory to a theatre, was built at a cost of $13.71 per sq. ft.

Strength . . . economy . . . versatility . . . simple, vigorous beauty—these are the qualities offered by Structural Steel; qualities proved time and again in structures that range from mighty, bustling skyscrapers to serene, single-story panoramas of steel and glass like Crown Hall.

Structural Steel is easily the most economical of load-carrying materials—and the strongest. It will take more abuse than other structural materials, effectively resisting tension, torsion, shear and compression. Enclosed in buildings, it lasts indefinitely, needing no maintenance. Structural Steel may be welded, riveted, or bolted, and can be erected in any weather. Since steel members are fabricated indoors, weather cannot affect the quality of workmanship.

CROWN HALL houses the Dept. of Agriculture, Institute of Design and Planning Dept. The entrance terrace is a gathering place for students between classes. The basement houses shops and classrooms.

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SOCIETY NEWS

Last Call for the Buffalo Convention

The Buffalo Section Steering Committee is emphasizing the mobile nature of the Society's Buffalo Convention, to which the Section will be host, June 3 through 7. In addition to the significant technical program, which will occupy four days and which was printed in the April issue, there will be tours and inspection trips galore. While major emphasis is being placed on the tour of the St. Lawrence Seaway and Power Project, the spotlight must be shared with some of the many other important engineering projects in which the Buffalo area abounds. Outstanding among these projects are Ontario Hydro's Sir Adam Beck Hydroelectric Station, the Lackawanna Plant of Bethlehem Steel, the New York State Thruway, and Niagara Mohawk's C. R. Huntley Steam Station.

The St. Lawrence Project

Before embarking on the St. Lawrence tour, which is set for June 6-8, engineers attending the Convention will be fully briefed on this great international engineering venture. All the participating Divisions are devoting one or more sessions to planning, design, and construction phases.

On Thursday evening, June 6, buses will leave the Hotel Statler, Convention Headquarters, for the Canadian National Railway Station at Fort Erie, Ontario, which is across the Niagara River from Buffalo. The "ASCE Special" will leave Fort Erie at approximately 9:30 p.m. and arrive at Cornwall, Ontario, early Friday morning, June 7. Accommodations will include roomettes and a few bedrooms and compartments.

The cost of the St. Lawrence Tour, including transportation, sleeping accommodations, and meals en route, will come to about $35 a person. Members wishing to provide their own transportation may meet the group at Cornwall, and proceed with it from this point. A special rate for this option will be available.

Members and their families will depart from Cornwall via buses to visit the various parts of the Seaway and Power Project. Construction activity will be at its peak at the time of the ASCE tour, according to officials of the project. First stops on the agenda will be the Grass River and Dwight D. Eisenhower locks. Each lock is 800 ft long, 80 ft wide and has a 30-ft depth over the sills. The two locks will lift vessels some 85 ft through the 10-mile Long Sault Canal. From there the tour will proceed to the Long Sault Dam, Barnhart Island Powerhouse, and the Iroquois Dam site on the United States side. The buses will then proceed to Ogdensburg, where they will cross by ferry to the Canadian shore and then go to the Iroquois Lock.

At the conclusion of the inspection trip, it's back to Buffalo, with arrival time scheduled for approximately 9:00 a.m. Saturday, June 8.

The ASCE Highway and Structural Divisions will sponsor a field inspection trip to the New York State Thruway for all interested members. As Buffalo is temporarily the western terminus of the Thruway, both completed portions and sites under construction will be available within the Buffalo area for the field trip. The 400-mile section from New York to Buffalo is now open, and an 80-mile section between Buffalo and the western border of New York State near Erie, Pa., is under construction.

The Bethlehem Steel Corporation's Lackawanna Plant will be host to the Structural Division. This installation is Bethlehem's third largest plant and the sixth largest in the world in terms of steel production. At the present time, it is producing 5½ million ingot tons annually which is in excess of its rated

Photo at left shows Niagara River and Falls model. This is a general view looking downstream. Intakes for diverting water to hydroelectric power plants downstream are located on both sides of the river. Model investigations were made to assist in the design of remedial works necessary to preserve the beauty of the Falls, and to compensate for the effects of additional diversions of water for power purposes. Engineer is shown removing miniature gates from proposed regulating dams. In right-hand view iron ore from the historic Mesabi range is unloaded at the Lackawanna plant of Bethlehem Steel by huge unloading machines which take 17 tons at a bite. Here is part of the Great Lakes fleet of ore vessels.

capacity. The strip mill and bar mill are among the points of interest to be included on the ASCE tour.

The Power Division tours include visits to the Canadian Sir Adam Beck Hydroelectric Station and to the Huntley Steam Electric Generating Station, both located on the Niagara River. The Structural and Construction Divisions are co-sponsors of the latter trip. Another feature of this Niagara trip will be a visit to the remedial works and weir above the Falls. This project was designed to provide more even distribution of flow over the brink of the Falls and to maintain desired water levels in the upper reaches of the river.

Unusual Ladies Program

The Committee feels that it has planned a most enjoyable program for the ladies fortunate enough to be attending the Convention in June. The kick-off will be a "Get Acquainted" Tea at the Hotel Statler on Monday.

A tour of the Niagara Frontier will be the big attraction on Tuesday. Buses will call for the ladies at the hotel in the morning. The sightseers will proceed to Niagara Falls and view the magnificent scene from both American and Canadian shores. A visit to Fort Niagara is also included. Luncheon at the Niagara Falls Country Club will be a highlight of the day. The club is beautifully situated at the top of the escarpment allowing a panoramic view of the countryside. The ladies will return to the Hotel Statler about 5:30 p.m.

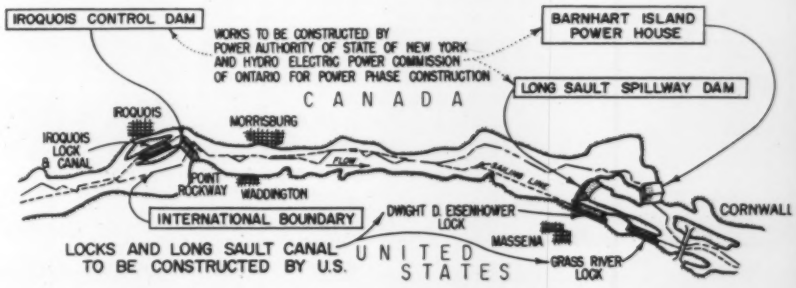
Wednesday has been left open for individual plans—shopping, visiting museums and art galleries, theaters, or perhaps an appointment at the beauty shop before the informal dinner dance that evening.

A luncheon at the Twentieth Century Club in Buffalo has been planned for Thursday. At this occasion a short film of the St. Lawrence Seaway will be shown to give the ladies a preview of what they will see the next day when they actually visit the project. Members of the Pittsburgh or Rochester Twentieth Century Clubs should bring their membership cards if they desire to take advantage of club facilities at another time.

On Thurday evening, the women will join their husbands to entrain for the St. Lawrence on a chartered all-Pullman train. They will arrive Friday morning ready for the tour of the international St. Lawrence Seaway Project. A bit of sound advice—include a comfortable pair of walking shoes in your bag.

The Women's Committee is looking forward to greeting all the ladies who can possibly come.

Long Sault Dam near Massena, N. Y., is one of the construction projects to be visited on the St. Lawrence tour at the Buffalo Convention. Concrete placing will be underway in the second-stage cofferdam for this 2,900-ft-long, 120-ft-high regulating dam. Major structures to be viewed include the 22,000,000-hp Barnhart Island powerhouse, Eisenhower and Grass River locks, and Iroquois Dam and lock as well as millions of yards of excavation.



Women's Activities Committee prepares for Buffalo Convention. The committee includes (in usual order) Mesdames Loren W. Olmstead, Robert C. Richert, Newell L. Nussbaumer, George F. Unger, Edward J. Nunan and Kenneth C. Swanson, and Miss Mildred E. Schudt.

Hal W. Hunt Appointed Executive Editor of "Civil Engineering"

Bringing to the Society long experience and an established reputation in both the construction and editorial fields, Hal W. Hunt, M. ASCE, has been appointed executive editor of CIVIL ENGINEERING.

For eight years in the 1940's Mr. Hunt was associate editor of *Engineering News-Record*, writing in the construction, business, and labor relations fields. He has also had a wide variety of construction experience with contractors and engineers, in both field and office. He has just returned from two and a half years in Spain, first as project engineer on design of the $70,000,000 naval port and airport development on Cadiz Bay for the Architect-Engineer Spanish Bases and then as chief engineer for Corbetta-Coviles on the construction of the $20,000,000 harbor at Rota. Earlier Mr. Hunt was with Corbetta on construction of the Bronx-Whitestone Bridge in New York.

Mr. Hunt is a civil engineering graduate of the University of Iowa and began his professional career with the Iowa Highway Commission. He is a professional engineer licensed in New York, Iowa and Oregon. In the 1930's he was project engineer for the Construction Plant Division of the Tennessee Valley Authority supervising design of plants for construction of major locks and dams.

Long active in the ASCE Construction Division, he has served it as program committee chairman and secretary. While in Portland, Ore., from 1951 to 1953 as resident engineer for Frederic R. Harris, Inc., of New York, on construction of a pier at Swan Island for the Port of Portland Commission, he started and edited the "Oregon Civil Engineer." This is the news sheet for the Oregon Section of ASCE.

Hal W. Hunt

As executive editor Mr. Hunt will work closely with Walter E. Jessup, longtime editor of the Society's official publication, to continue its growth and extend its influence.

Pipeline Division Committee Seeks to Standardize Pipeline Crossings of Railroads and Highways

A major step toward eliminating present problems connected with laying pipelines under railroad and highway crossings has been taken by the Society's newly formed Pipeline Division, which has set up a Committee on Pipeline Under Crossings of Railroads and Highways. The first task undertaken by the group will be to eliminate the confusion caused by the multitude and variety of existing specifications by recommending a standard for pipeline crossings.

The new committee is made up of twenty-five engineers representing railroads, the U. S. Bureau of Public Roads, the Federal Power Commission, pipeline groups, gas and petroleum organizations, and others. It is headed by J. E. Thompson, superintendent of construction for the Natural Gas Pipeline Company of America, Chicago.

In a statement of the committee's purpose, Chairman Thompson noted that, "The need for a standard for pipeline crossings for highways and railroads has become more urgent as longer and larger diameter pipelines are built which cross literally hundreds of different state and local highways as well as railroads with a single pipeline. One division of a railroad may have, and sometimes does have, different specifications from another division for the same class of road, and many highways are adopting codes which vary for the same class of construction.

"With the many different and varied specifications now in use, it has been increasingly difficult for pipeline companies to obtain the proper materials and design for each individual condition, since pipeline materials often must be ordered two years in advance of construction and many times before crossing permit data are available. It is believed that a properly developed standard could greatly facilitate the issuance of permits of railroads and highways, thus cutting down the volumes of correspondence often necessary for a single pipeline crossing. It will assure the railroad or highway department of a safe, well engineered crossing."

Mr. Thompson goes on to say that while the committee is not a code-writing organization, it will assemble and coordinate the engineering information contributed by the interested organizations. ASCE, he points out, "is a representative of all the interests involved, and is not attempting to suggest a code which will favor any particular group. The committee is aware, of course, that the pipeline companies will have to conform to existing piping codes and to the loading design of the highway or railroad.

"After the tentative specification prepared by the committee has been approved by the committee membership and by the American Standards Association, it will be adopted as a standard code for pipeline under crossings of railroads and highways."

At the Pipeline Division's first technical program at the Jackson Convention, Joseph B. Spangler, executive secretary of the Division, reported that a Highway Task Group—consisting of R. Robinson Rowe, Edward Kauffman, and Edwin H. Jones—had sent a questionnaire to the 48 state highway departments and had received replies indicating a widespread desire to cooperate in developing a standard.

New Appointment to ESPS Board

Bennett L. Raffin, M. ASCE, partner in Rothschild, Raffin & Weirick, has accepted appointment as representative to the San Francisco Advisory Committee for the Engineering Societies Personnel Service. Along with other representatives of the local sections of the cooperating engineering societies, Mr. Raffin will provide counsel, guidance, and review of operations in the San Francisco office of the ESPS with the aim of improving the Societies' employment service for Western engineers.

Thomas H. MacDonald, Hon. M. ASCE, Is Dead

Thomas H. MacDonald, Honorary Member of the Society and retired head of the U. S. Bureau of Public Roads, died suddenly at College Station, Tex., on April 7. He was 72. As chief of the Bureau of Public Roads for 34 years, Mr. MacDonald had an important role in developing the nation's modern highway system. He retired in 1953 and went to Texas Agricultural and Mechanical College, where he had the title of "Distinguished Research Engineer." For his road-building activities during the war President Truman awarded him the Medal of Merit. He was also decorated by France, Norway and Czechoslovakia. He was active in the Permanent International Association of Road Congresses and represented the United States at many international road shows.

Born in Leadville, Colo., Mr. MacDonald attended Iowa State Teachers College and graduated from Iowa State College as a civil engineer in 1904. After teaching at Iowa State he joined the Iowa State Highway Commission, becoming chief engineer in 1911. In 1919 he went to Washington to accept the position of head of the newly created Bureau of Public Roads.

Mr. MacDonald became an Honorary Member of ASCE in 1943.

Robert K. Lockwood Promoted to Assistant to Secretary of ASCE

In an expansion of the ASCE headquarters staff, Robert K. Lockwood, A.M. ASCE, has been transferred from the post of executive editor of CIVIL ENGINEERING to a positon as Assistant to the Executive Secretary.

Mr. Lockwood, a 1948 civil engineering graduate of the College of the City of New York and registered professional engineer in New York State, has been on the CIVIL ENGINEERING staff since the fall of 1948. He was associate editor until 1954, and since then has been executive editor.

In World War II Mr. Lockwood served in the Infantry, commanding a platoon in the Philippines. Later he was in charge of the industrial demobilization of Japan in a three-prefect zone, which included the second largest city in the island. Since the war he has been active in the Corps of Engineers Reserve and now has the rank of Captain. He is brigade engineer for the New York State Construction Brigade.

Mr. Lockwood has performed innumerable special editorial services for the Society, and has represented it on various technical and professional groups. He was active in the Metropolitan Section's Junior Forum, which he served as president. He was also a prime mover in starting the Section's newsletter four years ago, and has been editor of it since. Joining ASCE as a Junior Member in 1948, he transferred to Associate Member in 1952.

Robert K. Lockwood

In his new work Mr. Lockwood will be responsible for coordinating the Society's activities in the Department of Conditions of Practice now being handled by Assistant Secretary E. L. Chandler.

President Whitaker of ICE Entertained in New York

Sir Arthur Whitaker, KCB, president of the Institution of Civil Engineers (Great Britain), was entertained at a special luncheon at the Engineers Club on April 3 by a group of New York engineers, including present and past officers of ASCE. For nearly 40 years of his unusual career President Whitaker has been in Her Majesty's service. He was engaged on Admiralty, dockyard, and naval base projects both at home and abroad—Jamaica, Malta, and Singapore. In 1940 he was appointed civil engineer-in-chief to Admiralty, a position he held until he retired in 1954 to become a partner in the firm of Livesey and Henderson, consulting engineers.

He was guest of honor at the monthly luncheon of the American Institute of Consulting Engineers, where he spoke of the difficult and expensive engineering problems connected with improving the capacity of the Suez Canal. Because of Sir Arthur's membership on the Commission Consultative Internationale des Traveaux of the Suez Canal Company, his comments were of particular professional interest.

Four ASCE Past-Presidents attend cocktail party honoring president of Institution of Civil Engineers of Great Britain. Seen here (in usual order) are ASCE Executive Secretary William H. Wisely; Enoch R. Needles and Richard E. Dougherty, Past-Presidents of ASCE and New York City consultants; Sir Arthur Whitaker, president of Institution of Civil Engineers, London; Carlton S. Proctor and Malcolm Pirnie, Past-Presidents of ASCE and New York City consultants; and Capt. F. C. Theobald, consulting engineer for the Union Carbide and Carbon Company.

Philadelphia Nuclear Congress Largest Since Geneva

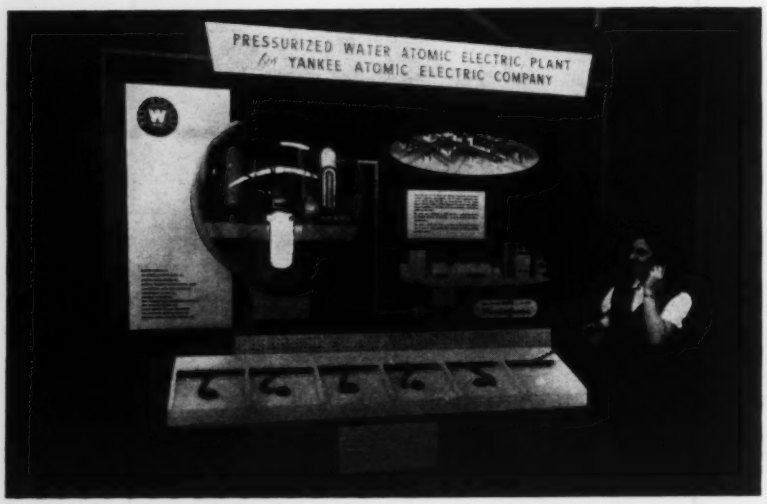
Some 8,400 engineers and scientists met in Philadelphia, March 11-15, in what was probably the largest gathering of the atomic power industry ever held in the United States. Seeking to bring together all the facets of the industry at one time, the Congress embodied four major segments: the Second Nuclear Engineering and Science Conference; the Fifth Atomic Energy in Industry Conference; the Fifth Hot Laboratories and Equipment Conference; and the International Atomic Exposition. The entire Congress was coordinated by Engineers Joint Council.

Among the new techniques unveiled at the meeting was the co-precipitation process for the removal of radioactive wastes developed at Hanford. The process is a simple volume reduction by carrier precipitation. Highly radioactive cesium-137 and strontium-90 are deposited out of large volumes of aqueous waste solutions by co-precipitation with metal ferrocyanides.

In speaking of the water pollution problems associated with the atomic energy industry, E. C. Tsivoglou and W. M. Ingram, of the Taft Sanitary Engineering Center, and E. D. Harward, of the Atomic Energy Commission, stated in their paper that, "The water pollution problems associated with the atomic energy industry are similar to those encountered with other industries, except for the nature of the pollutant and details such as measurement techniques. Hence, it is anticipated that control of radioactive wastes from this industry will be administered by existing regulatory agencies, according to the same general methods and policies practiced for other more familiar industrial effluents. Stream surveys for radioactive waste control, and the interpretation of the data collected, differ somewhat from those for more ordinary water pollutants because of the peculiar character of radioactive wastes and the manner in which they affect the stream. One reason for this is that there exists no stream self-purification capacity for radioactive wastes in the sense that a stream purifies itself of organic pollutants."

Of particular significance to the profession was discussion of the use of radioactive tracers for engineering studies. P. F. Carlton, of the Corps of Engineers, told of the success of studies of their use in determining moisture content and density of soils. Studies at the Robert A. Taft Sanitary Engineering Center, Cincinnati, in which radioactive tracers were used to determine flow time and dispersion, were described in a paper by Conrad P. Straub, chief of the Radiological Health Program, and C. Richard Hagee, in charge of instrumental and physical methods. Of most importance to the profession as a whole have been the studies utilizing these new tools for the measurement of longitudinal mixing in pipes, determination of flow time and dispersion in water courses, artificial basins and ground water, distribution of pollution from ocean outfalls, evaluation of the removal of bomb debris from the atmosphere by the environment and by water treatment plants, and for rapid detection of coliform organisms.

On the structural side H. T. Evans of Stone & Webster, architect-engineer for the Shippingport Atomic Station (October 1956 issue, page 56), noted the significance of structural engineering to the atomic program. He stated that, "The plant for the disposal of radioactive wastes at the Shippingport Atomic Power Station occupies an area of more than an acre adjacent to the main plant. Unlike the main plant, its design involved no unusual structural problems and the layout was not limited by structural requirements. Nevertheless, the structural work is of such extent that its cost has been estimated as approximately 40 percent of the total cost of the waste disposal plant. This is a considerably higher proportion than in the main plant and is much higher than is usual for steam power stations and process plants in general."



This model of the pressurized water reactor being developed by Westinghouse for the Yankee Atomic Electric Company's 134,000-kw plant near Rowe, Mass., was Atomic Exposition highlight. Atomic reactor, surrounded by steam generators, can be seen at left. The fabricated fuel rods in the reactor contain enough uranium to support an atomic chain reaction, which in turn produces heat for converting water to steam. This steam drives the turbine and electric generator, seen at right in model, to produce electric power.

First "Critical" Reactor Exhibited

Among the more spectacular exhibits at the Atomic Exposition was the first "critical" reactor ever publicly exhibited in this country. The reactor was a model of the pressurized water reactor being built by Westinghouse for the Yankee Atomic Electric Company. The model contained enough uranium to support an atomic chain reaction, power from which was used to open the Congress. Also on exhibit was an atomic powered battery about the size of a cough drop, which has a life of five years and can be used to power such items as hearing aids, portable radios, and eventually wrist watches.

The purpose of the Congress was to stimulate the free exchange of information concerning the atomic sciences, thereby speeding the growth of the industry and hastening the ultimate development of peaceful uses of this most

important energy source. To this end the Congress was eminently successful.

Congress Papers Available

A list of the Nuclear Congress papers is available on request, and individual papers may be purchased, at 30 cents apiece, until January 1958. Inquiries and orders should be sent to T. A. Marshall, Jr., Nuclear Congress Manager, 29 West 39th Street, New York 18, N. Y. The bound Proceedings of the Congress will be available later in the year. The price has not yet been determined. Complete transcripts of the Atomic Energy in Industry Conference are available now at $15 from the Director, Conference Division, National Industrial Conference Board, 460 Park Avenue, New York 22, N. Y. Bound sets of the papers presented at the Hot Laboratories and Equipment Conference sell for $10 each, and orders for these should also be sent to Mr. Marshall.

Joint Committee on Composite Construction Activated

The new technical Committee on Composite Construction got to work at its first meeting, held in Dallas, Tex., late in February. This committee—formed jointly by the ASCE Structural Division and the American Concrete Institute—has the objective of preparing a recommendation for the design and construction of structures composed of prefabricated beams and cast-in-place slabs. It will consider all types of composite construction pertaining to flexural members for buildings and bridges. Emphasis will be placed on steel beams with concrete slabs and on precast concrete beams with cast-in-place slabs.

At the Dallas meeting the fifteen members of the committee were divided into five task groups, each charged with studies of one of the following subjects: Design methods; deformational stresses; shear connection between the component elements; effective slab width and negative moment region; and deflections and vibrations. Each task group is expected to prepare a report summarizing the available information on the subject under study, pointing out the area of need for additional information, and indicating how it can be obtained.

The committee also considered a proposed research project concerned with methods of connecting a precast concrete beam with a cast-in-place reinforced concrete slab. The possibility of cooperation with the American Institute of Steel Construction in studying composite construction in steel and concrete was discussed.

Dr. Ivan M. Viest, of the University of Illinois, is chairman of the Committee on Composite Construction. For the Structural Division, this activity is coordinated by Leo H. Corning, member of the Division's Executive Committee.

New Chairmen of ASCE Professional Committees

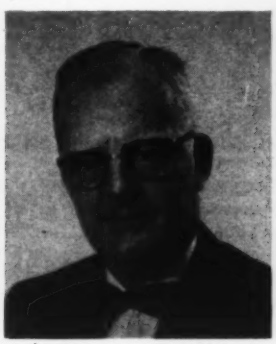
TRENT R. DAMES
Committee on Junior Members

ELMER J. MAGGI
Committee on Local Sections

EMORY E. JOHNSON
Committee on Student Chapters

ROLAND P. DAVIS
Committee on Engineering Education

DAVID G. BAILLIE
Registration of Engineers



HERBERT C. GEE
Committee on Professional Practice

DON H. MATTERN
Committee on Salaries

JACK Y. LONG
Committee on Employment Conditions

Joint Honors Awarded at AIME Annual Meeting

Herbert Hoover, Jr., former Under Secretary of State (above, right) receives the Hoover Medal, named after his father and sponsored by the Four Founder Societies. The award, made by engineers to a fellow engineer for distinguished public service, was presented at the AIME Annual Meeting in New Orleans by H. DeWitt Smith, of New York, past-president of the Institute.

Former President Hoover was the first recipient of the Medal in 1930. He is senior past-president of the Institute. Mohamed Mortada (above, left) receives Alfred Nobel and Rossiter Awards from Carl E. Reisle, Jr., outgoing president of AIME, at its annual meeting in New Orleans. Alfred Noble Prize is joint award of Four Founder Societies and Western Society of Engineers.

Intersociety Sanitary Engineering Board Meets

At a special meeting held in Washington on March 5, the Board of Trustees of the American Sanitary Engineering Intersociety Board accepted 98 additional applicants for certification without examination. This brings the total close to the 300 mark. The next meeting of the Board at which applications can be considered will be held during the Annual Convention of the ASCE in New York City, October 14-18.

Several other important actions were taken. The American Institute of Chemical Engineers had previously been accepted as a sponsor of the ASEIB Board, and nominees to the Board of Trustees were elected members. These are Larry W. L. Faith, director and chief engineer, Air Pollution Foundation, Los Angeles, Calif.; K. S. Watson, General Electric Company, Schenectady, N. Y.; and R. F. Weston, Weston Eckenfelder and Associates, Newtown Square, Pa.

It was agreed to extend an invitation to the American Industrial Hygiene Association to serve as a Board sponsor in order to identify the industrial hygiene engineers with its activities. In order to provide the members of the AIChE and the AIHA an opportunity to take advantage of the "grandfather's" section without examination, the deadline for receipt of applications for consideration for certification without examination was extended from July 1 to October 1, 1957.

ASCE Honorary Member Frederick Ohrt Dies

Frederick Ohrt, Honorary Member of ASCE and retired manager and chief engineer of the Honolulu Board of Water Supply, died in a hospital in that city on March 28. Connected with the Honolulu Board of Water Supply from 1925 until his retirement four years ago, Mr. Ohrt was widely acclaimed for his work in transforming Hawaii's water system into one of the best in the United States. Since his retirement he had been trustee of the James Campbell Estate, one of Hawaii's two largest trusts.

Born on the Island of Maui, when the Hawaiian Islands were still a kingdom, Mr. Ohrt was educated on the mainland. He attended the University of Oregon, and in 1911 received his C.E. degree from Cornell University. Later he did graduate work at the Harvard-MIT school for health officers.

In his work in Hawaii he initiated broad-scale research in groundwater. He also contributed to knowledge of salt water intrusion on the Pacific, and wrote several papers on the subject. During the war he was consultant to the Navy on the development of water supplies on the Pacific Islands. Active in civic projects, he was largely responsible for present laws on civil service, classification, and the retirement pension plan for government employees.

Frederick Ohrt

Long active in ASCE, which he joined as a Junior Member in 1912, Mr. Ohrt was elected Honorary Member in 1951.

Hydraulics Conference To Be Held at M.I.T.

A tentative program has been arranged for the ASCE Hydraulics Division Conference, to be held at Massachusetts Institute of Technology, August 26-28. Monday, August 26, will be devoted to sessions on hydraulic research and design; Tuesday to sessions on tidal hydraulics and inspection trips to Boston Harbor, Boston Army Base, and Charlestown Navy Yard; and Wednesday to study of hydrology and floods and sedimentation. On Thursday there will be a trip to Plymouth, the Cape Cod Canal, and the Woods Hole Oceanographic Institution. The complete program will be published later.

Information from the ASCE Hydraulics Division Conference Committee, Room 48-207, Hydrodynamics Laboratory, M.I.T., Cambridge, Mass.

ASCE MEMBERSHIP AS OF APRIL 9, 1957

Members	9,376
Associate Members	12,545
Junior Members	17,483
Affiliates	73
Honorary Members	43
Total	39,520
(April 9, 1956	38,784)

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

Dario Travaini, past-president of the **Arizona Section,** has been honored with the title of Arizona Professional Engineer of the Year by overwhelming vote of the engineers of the state. With the City of Phoenix since 1931, Mr. Travaini is now general superintendent of water and sewers and heads studies of major expansion requirements of the city in water and sewer systems. He is considered one of the top sanitary engineers in the country, and his early work at the Phoenix activated sludge plant brought visitors from all over to study his techniques—sludge thickening aided by chlorination, for one. Mr. Travaini is also known for his part in developing processes for the manufacture of sulphuric acid and ferric sulfate usable in mine leaching and other treatment processes.

If every registered vehicle in the United States carried three people, the entire population of the United States could be on wheels at one time. This is one of the dramatic facts brought out by J. E. Baerwald, assistant professor of traffic engineering at the University of Illinois, in a talk pointing up the seriousness of the traffic situation at the **Central Illinois Section's** March meeting. At present, he said, there are 63,000,000 registered vehicles, and it is estimated that by 1975 this number will be doubled. Steps being taken to cope with the traffic congestion, present and anticipated, include studies of accident types and distribution and considerable experimentation with traffic signs and lights. At the February meeting Prof. W. W. Hay spoke on the selection of railroad routes in South Africa. Professor Hay spent several recent summers there helping the government and industry with their transportation problems.

In April the **Cleveland Section** put on a TV program entitled "You Can Be an Engineer." The program, featuring a construction film of the city's new Central Viaduct, is one of a regular series of Sunday broadcasts, sponsored by the Cleveland Technical Societies Council. The city high schools are kept informed of the program, which is called "Science Lab." An informative talk about high-strength steels and possible uses in modern design was the highlight of the February meeting. The speaker was John A. Gilligan, head of the Engineering Mechanics Section of the United States Steel Corporation's Applied Research Laboratory.

In a talk on the Southeast's water pollution program, featured address at the **Georgia Section's** April meeting, Lewis A. Young stated that primarily it is the role of the individual state to program its activities, which in turn are supplemented by the federal government. The **Albany Branch** reports that Lt. Jack Reeve, CEC, USN, has been appointed to succeed J. R. Fraser as Branch secretary-treasurer. The March meeting of the **Central Savannah River Valley Branch** was a joint session with the Joint Engineers Council during Engineers Week. Dean Jesse Mason, of Georgia Institute of Technology, was principal speaker with a talk on today's engineering education problems.

Joel B. Cox, prominent Honolulu engineer, was honored at the **Hawaii Section's** January meeting with a Life Mem-

Taking part in the Kentucky Section's play-off for the annual D. V. Terrell Award (a Junior Member prize-paper competition) are Frank D. Whitney (left) and Milton Evans, Jr. Mr. Evans, the winner, then became the Section's representative in the final competition held during the District 9 Council meeting in Columbus on April 13.

"Improvements to Baltimore Harbor and Channels" was the Maryland Section's February meeting topic. Seated at head table (starting at left and proceeding clockwise around table) are John T. Starr, chairman of Section's Waterways & Harbors Committee; Robert W. Williams, chairman, Maryland Port Authority; Herschel H. Allen, past-president of Section; Section Vice-President Albert L. Grubb; Section President Charles L. Kroll; James W. Davis, secretary-treasurer; W. Watters Pagon, past-president of Section; D. Luke Hopkins, vice-chairman, Maryland Port Authority; Joseph L. Stanton, executive director, Maryland Port Authority; and Michael A. Kolessar, chief of Navigations Reports Section, Baltimore District of the Corps of Engineers. Messrs. Kolessar and Starr were featured speakers.

Los Angeles Section is becoming increasingly aware of the important part its Junior Member Forum plays in its affairs. Pictured here (seated in the usual order) are the following officers for the current term: Leroy Crandall, senior adviser to the Forum; William J. Keener, president; and Rodney P. Lundin, secretary. Standing are Robert F. Clawson, treasurer, and Harry F. Blaney, Jr., vice-president. First vice-president Louis R. Hovater was away on business and unable to attend the meeting. The Forum is 27 years old this spring, having held its first meeting on March 12, 1930. The idea of Junior Forums is thought to have originated with the Los Angeles Section.

bership Certificate. A native Californian, Mr. Cox has spent practically his entire professional career in Hawaii. For many years he was chairman of the Territory Board of Registration of Engineers, Architects and Land Surveyors. The Section has a flourishing ASCE Wives' Auxiliary, which reports the following officers for 1957: Mrs. Donald S. Austin, president; Mrs. Edward Morgan, vice-president; Mrs. Russell L. Smith, Jr., secretary; and Mrs. William Tinniswood, treasurer. A panel discussion devoted to raising professional standards and improving employment conditions for engineers was sponsored by the Section on February 14. Taking part were William M. Wachter, superintendent of public works for the Territory of Hawaii, who discussed engineering as a profession; Paul Liu, engineer with Austin & Towill, who outlined the employee's responsibilities; Paul Wainwright, chief engineer of the Hawaiian Dredging & Construction Co., who spoke for management; Robert Chuck, treasurer of the Section, spokesman for the engineering societies; and L. Scott Daniel, chairman of the department of engineering at the University of Hawaii, who analyzed the role of the engineering educator. Robert M. Belt, general manager of Belt, Collins & Associates, was moderator.

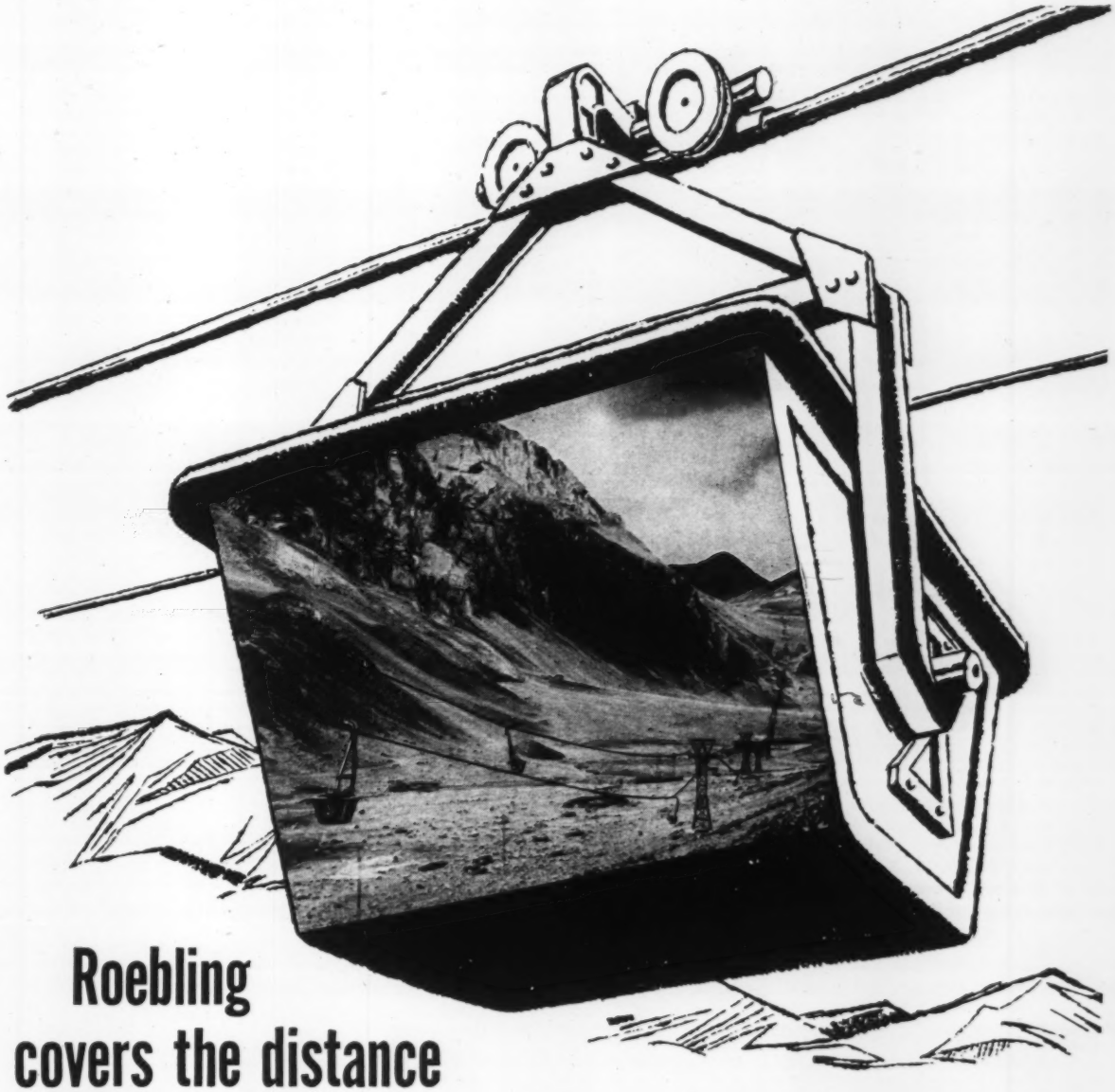
Presidents, past and present, of engineering groups attending the Kansas City Section's March meeting include (left to right) Section President W. G. Riddle; S. J. Callahan, past-president of Section (1947); Garvin Dyer, president-elect, National Society of Professional Engineers; Joseph Sorkin, past-president of Section (1949); ASCE President Mason Lockwood; John Q. A. Greene, past-president of Section (1951); and William L. Patterson, president of Kansas City Engineers Club and another past-president of the Section (1952). In the featured address Mr. Lockwood told an audience of 200 that the engineer-income situation "has settled into an enormous disparity—satisfactory starting salaries for young engineers, inadequate advances in income and status and prestige for mature, experienced men."

In the **Indiana Section's Northwestern Branch** the 1957 slate is William D. Shillinger, president; Leo Louis, vice-president; and A. P. Arndt, secretary-treasurer.

The status of bills in the Utah Legislature that will affect the engineering profession was reported at a recent **Intermountain Section** meeting by Milt Wilson, member of the Utah Engineering Council Legislative Committee. Technical speaker on the program—a joint session with the Ogden Engineers Club—was an engineer with the Marquardt Aviation Corporation, who discussed the company's building and expansion program in the state.

The **Kansas City Section's** Junior Activities Committee arranged a timely meeting for the Section on March 19 devoted to electronic digital computers in highway engineering. The speaker was L. E. Knutson, of Remington Rand's Univac Division, who explained the fundamentals of these high-speed electronic computers. An enthusiastic discussion from the floor on specific applications and the cost of electronic brains concluded the program.

At a recent joint meeting of the **Lehigh Valley Section** and the local group



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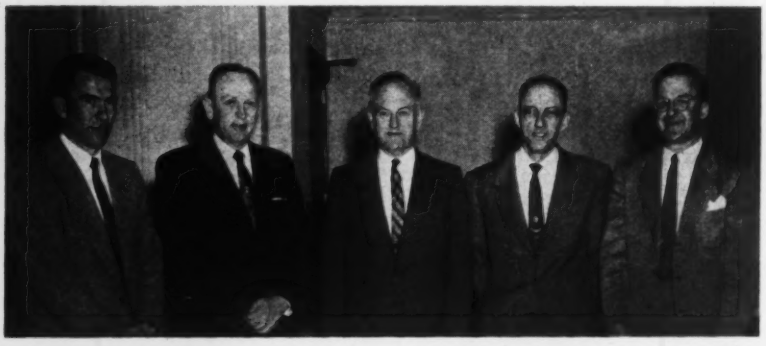
At recent Philadelphia Section social evening Member Samuel I. Sacks and Mrs. Sacks (left) gave illustrated talk on their recent 60-day flight around the world. Shown with them are Mrs. Joseph R. Farrell, chairlady, and Section President Victor G. Thomassen. The Sacks visited 15 countries.

Panama Section takes part in Engineers Week celebration in the Canal Zone. Seated at head table at large dinner in Ancon on March 1—climax of the week-long celebration—are (left to right) Col. and Mrs. R. L. Hill, president, Canal Zone Post, Society of American Military Engineers; Section President and Mrs. Celso Carbonell; Governor and Mrs. W. E. Potter; and Col. Hugh M. Arnold, chairman, Engineers' Week Steering Committee. In the featured address Governor Potter proposed expansion of the Canal Zone domestic water system.



Wyoming Section members turned out in force for the Section's recent nineteenth annual business meeting and dinner—a gala occasion, with President Mason Lockwood and Vice-President Norman Moore as special guests. Pictured at the afternoon business meeting are (left to right) D. B. Simmons, president of the Section; President Lockwood; Vice-President Moore (Zone III, Vicksburg); J. H. Zoller, president-elect of the Section; and N. D. Morgan, Jr., secretary-treasurer of the Section. Other new officers, installed during the meeting, are Glenn B. Mullens, vice-president; Donald R. Lamb, assistant to the president; and Arthur C. Volk, assistant to the secretary.

of the American Welding Society Richard Van Vliet, of the Pennsylvania Power and Light Company, described one of his company's recent projects—a 15-ft-dia welded steel pipeline. The new pipeline has been installed as replacement for an old wood stave line used to conduct water from the dam to the powerhouse at the company's Wallenpaupack hydroelectric development.

Finley B. Laverty has been designated "the engineer who has done the most for the **Los Angeles Section** and the civil engineering profession in the area in the past several years." A past-president of the Section and current Director of ASCE, Mr. Laverty has achieved a dual career—as practicing engineer and in the professional aspects of engineering education. He has been chief hydraulic engineer for the Los Angeles County Flood Control District since 1934, and is an authority on water conservation, reclamation of waste water, and flood control. His activities for the advancement of engineering education include five years as member and chairman of the Society's Committee on Student Chapters.

Civil engineering students from the University of Maryland and Johns Hopkins were in charge of the **Maryland Section's** March meeting. Featured speakers at this traditional annual event were Stewart Anderson and Francis Steinbaurer, of the University of Maryland Student Chapter, who collaborated on a paper on "Iron Mining in Minnesota," and James J. Valis, of the Johns Hopkins Student Chapter, whose topic was "Shopping Centers—A Modern Phenomena."

In vigorous support of the Society principle that important engineering posts should be occupied by qualified engineers, the **Michigan Section** joined other engineering groups in the state in questioning the qualification of one of the candidates for state highway commissioner in a recent special election. Though the candidate in question is an engineering school graduate, he has not qualified as a registered professional engineer. However, he had powerful labor backing and won the election, despite the stand of professional groups that "for the state highway commissioner to be other than a registered professional engineer would be to make a mockery of the provisions" of the Michigan Registration Act. According to Section President Lloyd T. Cheney, professional groups "do not consider the matter closed by any means until the Court has ruled on this man's qualifications."

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Planning and design considerations that must be taken into account in building to withstand the effects of nuclear weapons made up the subject of the technical program at a recent meeting of the **Mid-South Section's Memphis Branch.** Navy Ensign Gifford H. Albright, who is special projects officer in the Atomic Energy Branch of the Research Division at the Bureau of Yards and Docks, was featured speaker. Members of the **Vicksburg Branch** attending a joint luncheon with the local post of the Society of American Military Engineers, on February 4, heard Col. James B. Lampert, special assistant to the Chief of Engineers for nuclear power, review progress being made in atomic developments for military use.

Featured speaker at March meeting of Oklahoma Section's Tulsa Branch was Bernard M. Monaghan (third from right), chief engineer of the Quebec, Northshore and Labrador Railway, Seven Islands, Quebec. Shown with him are Col. John D. Bristor, Tulsa District Engineer, Corps of Engineers; Wayne D. Branick, Oklahoma Section president; Brig. Gen. L. E. Seeman, Division Engineer, Southwest Division; Jack B. Cornett, chairman of Tulsa Branch; Mr. Monaghan; Douglas J. Tilden, Arrangements Committee; and Wilbur White, social host's representative. Photo courtesy "Casper Morning Star."

How the modern army gets its equipment—some of it can be purchased outright and some of it has to be designed and made especially for the military—was featured subject at a recent joint meeting of the **Northwestern Section** and the Society of American Military Engineers. Robert G. Alexander, chief of the Construction Equipment Division of the Corps of Engineers at Fort Belvoir, was the speaker.

The pioneer days of railroading and their almost insurmountable problems came alive on the evening of March 11 for members of the **Oklahoma Section's Tulsa Branch,** who heard Bernard M. Monaghan, chief engineer of the Quebec, North-shore and Labrador Railway, speak. Mr. Monaghan described the original route surveys for his company's recently completed railroad across difficult snow-covered terrain and Labrador muskeg (with dog sled the favored transportation). The 356-mile line was built to bring iron ore from the recently discovered deposits south of Ungava Bay to dock facilities at Seven Islands on the St. Lawrence. Mr. Monaghan makes his home at this southern terminus. With the aid of colored slides Mr. Monaghan also told of the many other projects involved in support of the vast strip-mining operation.

This contingent of University of Oklahoma Student Chapter members attended Jackson Convention as guests of the Oklahoma Section. Shown in the front row, left to right, are Floyd Hensley, Dale Smith, Roy Hann, and Frederick Spitz; second row, James Horn, Royal Cline, and Howard Russell; and back row, Don Clark, Dan Potts, and W. D. Sharbrough, Jr. Glenn Bayless was absent when photo was taken. The petroleum and asphalt industries and various engineers and contractors aided the Section in financing the trip.

Engineers in Panama and the Canal Zone were leaders in an impressive Engineers' Week celebration, February 24 through March 2. Sponsoring groups were the **Panama Section,** the Canal Zone Post of the Society of American Military Engineers, and the Panama Society of Engineers and Architects. To stimulate interest in engineering as a career essay contests on the subject were conducted in the Balboa and Cristobal high schools, with money prizes and certificates for the winners. The lucky ones were announced during a special hour-long Engineers' Week TV program. In addition to the broadcast, a series of talks was given at all the service clubs in Panama and the Canal Zone. On the social side, there were a boat trip through Gaillard Cut and picnic for engineers and their guests. A dinner party

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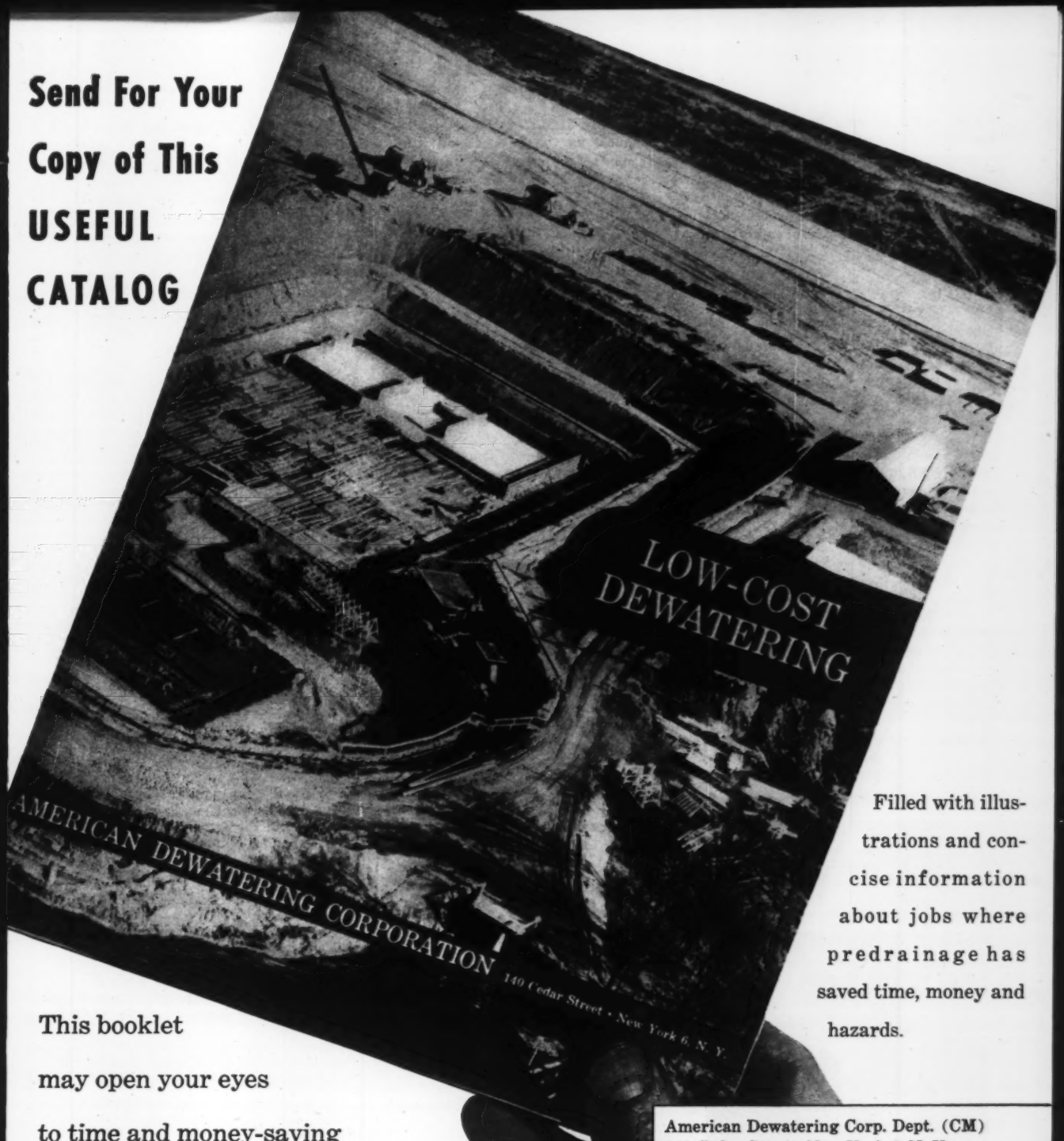

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for 300 at Tivoli Guest House in Ancon (see photo) brought the fruitful week to a close.

Congratulations are in order for the **Rhode Island Section,** which adds an interesting mimeographed monthly to the ever-growing list of Section newsletters. The March issue points with pride to a long list of Section members who are actively helping Rhode Island's ambitious new expressway system to take shape. This spring the Section is sponsoring a series of Friday night classes on prestressed concrete, with instructors from the Portland Cement Association.

The **South Carolina Section's** new **Northwest Branch** got off to a good start with an organization meeting in Greenville on March 12. J. C. Voorhees, vice-chairman of the Committee on Local Sections, did the honors for ASCE in an informal address explaining the relationship between the Society and its Sections and Branches. First Branch officers, elected during the meeting, are George W. Cumbus, president; John M. Ford, Jr., vice-president; and J. Thomas Cox, secretary-treasurer.

Horace J. Whitacre, Jr., Tacoma consultant and prominent member of the **Tacoma Section,** is the first recipient of the Tacoma Engineer of the Year Award, given in recognition of his outstanding achievements in civic and technical affairs last year. Jack D. Stevens, consulting engineer for the Puget Sound Utilities Council, Seattle, spoke on the power situation in the Northwest at the February meeting.

Toledo Section members learned a great deal about aerial photography and photogrammetry at their February meeting. A staff member of Land and Air Maps, Inc., spoke and then escorted the group around its offices. Charles H. Kurtz heads a committee that will study the feasibility of publishing a Section newsletter.

Ways of keeping up interest in the Society and the Section—always a problem in large sparsely populated Sections—came in for much discussion at the **Wyoming Section's** annual business meeting on March 14 (photo on page 82). In addition to the regular agenda, it was finally decided to have two special all-day technical meetings—one in the fall (in connection with some football game) and the other in the spring. The Section's monthly newsletter will also be resumed. ASCE President Lockwood and Vice-President Moore were guests at the meeting and the dinner that followed—the first meeting in the history of the Section attended by both the Society President and Zone Vice-President. Local and national relationships in engineering organizations were analyzed by Mr. Lockwood in the leading talk. Mr. Moore also spoke interestingly on the subject, "This Is No Time for Self-Satisfaction." New Section life members are Noah E. Wolfard and Zina E. Sevison.

George D. Camp (left) receives his Life Membership Certificate from Lorenzo Perez Castro, retiring president of Mexico Section, at recent Section meeting. New Mexico Section officers, installed during the meeting, are Leopoldo Farias S., president; José Vicente Orozco, vice-president; and Miguel Montes de Oca A., secretary-treasurer.

ASCE CONVENTIONS

BUFFALO CONVENTION
Buffalo, N. Y.
Hotel Statler
June 3-7, 1957

ANNUAL CONVENTION
New York, N. Y.
Hotel Statler
October 14-18

CHICAGO CONVENTION
Chicago, Ill.
Sherman Hotel
February 24-28, 1958

TECHNICAL DIVISION MEETINGS

AIR TRANSPORT CONFERENCE
New York, N. Y.
Park Sheraton Hotel
May 15-17

WORLD STRUCTURAL PRESTRESSED CONCRETE CONFERENCE
San Francisco, Calif.
Fairmont Hotel
July 29-August 2

HYDRAULICS CONFERENCE
Cambridge, Mass.
Mass. Inst. of Tech.
August 26-28

WATERWAYS & HARBORS CONFERENCE
Princeton, N. J.
October 18
(Part of Annual Convention program)

Local Section Meetings

Alabama—All-day summer meeting at the Jefferson Davis Hotel, Montgomery, June 7. Family dinner in the evening.

Hawaii—Annual all-day spring conference at the Hawaiian Village Hotel, Waikiki, Oahu, May 15. With the theme of irrigation, the event is especially arranged for the convenience of engineers in San Francisco to attend the Intersociety Conference on Irrigation and Drainage and the Third World Congress on Irrigation and Drainage.

Los Angeles—Annual spring banquet of the Junior Member Forum at the Smoke House (4420 Lakeside Drive, Burbank), May 17, at 7:30 p.m. (social hour at 6:30 p.m.); dinner meeting of the Soil Mechanics Group at the Rodger Young Auditorium (936 West Washington Blvd), May 15, at 6:30 p.m.; dinner meeting of the Sanitary Group at the Los Angeles Engineers Club, May 22, at 6:30 p.m.; and dinner meeting of the Transportation Group at Taix French Restaurant (321 East Commercial, Los Angeles), May 23, at 6:30 p.m.

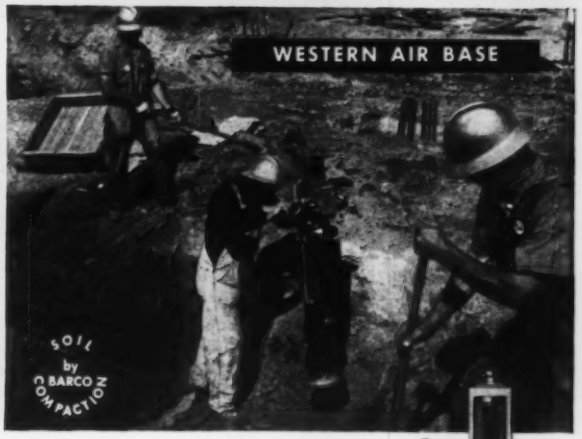
Metropolitan—Meeting in the Auditorium of the Engineering Societies Building, New York, May 15, at 7:00 p.m.

Philadelphia—Annual dinner meeting at the Engineers Club, May 14; annual meeting of the Trenton Branch at Glendale Tavern on May 21.

Tennessee Valley—Spring meeting at the Manor in Asheville, N. C., May 17 and 18, with the Asheville Branch as host.

Wyoming—Joint meeting with the University of Wyoming Student Chapter at Laramie, May 14, at 7:30 p.m., preceded by a dinner in the university cafeteria.

GASOLINE **BARCO** RAMMER



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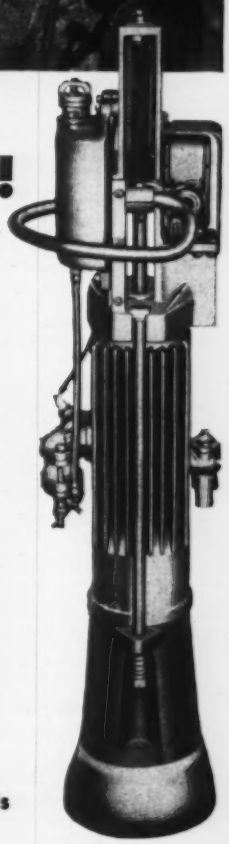
In test after test, Barco Rammers have demonstrated their ability to deliver 95% to 97.5% compaction (modified Proctor Method)—EASILY! EFFICIENTLY! ECONOMICALLY! The Barco Rammer is especially useful for compacting fill in restricted areas—close to walls, culverts, abutments, around footings, and in trenches. ONLY the Barco Rammer can produce specified high degree compaction on lifts up to 20 inches.

Gets jobs finished on time—
One of the biggest advantages offered by Barco Rammers is ability to handle work in minimum time. On area tamping, one man can average 20 to 30 cubic yards of fill per hour. On trench backfill, using lifts up to 24″, the rate for 18″ trench is 360 to 600 feet per hour.

Barco performance pays dividends! We will be glad to arrange a demonstration for you—see our nearest dealer or write.



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BY-LINE WASHINGTON . . . . . .

A number of bills directly affecting civil engineers as professional men are either at a standstill or torpidly moving forward in the 85th Congress. Two of major interest just now are:

The Moss-Gubser bill . . . to reestablish a separate schedule for professional employees of the federal government. The 5,300 civil engineers who work for Uncle Sam would automatically fall into this new category ("SPS"—Scientific and Professional Schedule) and become eligible for the higher salaries it would carry.

The Jenkins-Keogh bill . . . to set up a voluntary pension plan for self-employed engineers. The proposed legislation would permit such persons to put aside up to 10 percent of their net earnings, not to exceed $5,000 annually, for retirement. This money would be tax deductible.

The Moss-Gubser proposal is one of many measures being pushed to make federal employment more attractive to engineers. Engineers are currently in a broad category comprising one million other federal workers, and it has been impossible to boost their salaries without upgrading the entire classification. Under the separate salary schedule proposed by Congressmen Moss and Gubser, federal government manpower advisers feel, Uncle Sam can draw his share of men from the engineering manpower pool.

Here is the compensation table proposed by the Congressmen. Federal engineers presently classified as GS-5 would become SPS-1; GS-6 would become SPS-2, etc. Raises are in seven annual stages, ranging from:

Grade		
SPS-1	$5,070	$5,850
SPS-2	5,980	6,760
SPS-3	6,890	7,670
SPS-4	7,800	8,580
SPS-5	8,710	9,610
SPS-6	9,760	10,660
SPS-7	10,810	11,710
SPS-8	11,860	12,760
SPS-9	12,910	13,930
SPS-10	14,100	15,120
SPS-11	15,290	16,310
SPS-12	16,480	17,500
SPS-13	17,670	18,810
SPS-14	19,000	

Unfortunately, at this writing, the bill is on dead center. No hearings have been held or are scheduled by the House Civil Service Committee where the proposal (HR 2803, 2804) is on the shelf. On the Senate side, Sen. Olin D. Johnston, chairman of the Senate Civil Service Committee, has fathered a companion bill with the same salary schedule. Proposed rates are 38 to 70 percent higher than at present and substantially more than current salaries in non-government work.

ASCE has been one of the most active supporters of the Jenkins-Keogh proposal, a measure which would give self-employed civil engineers as well as other such professional people, some of the advantages now enjoyed by employees covered under private pension plans.

When hearings on a similar measure were held two years ago, ASCE's representative pointed out that professional *salaried* employees derive a marked advantage under company pension plans in which their employer makes contributions. *Businessmen* can accumulate retirement funds which are taxable more leniently as capital gains. The *self-employed* professional man, on the other hand, enjoys neither of these advantages and the government's present income tax schedule does not permit him a tax incentive to lay aside money for his retirement years. The Jenkins-Keogh bill would provide this incentive.

Again, since the extensive investigation in 1955, no action has been taken on this proposal. The bills (HR 9 and 10) introduced this session differ mainly on two points from those filed last year. They have reduced the amount which would be allowed as tax deductible from $7,500 a year to $5,000, and the maximum aggregate amount deductible from $150,000 to $100,000.

* * *

The Administration's plans to curtail the urban renewal program drew vitriolic comment from Congressmen, municipal leaders, and public works officials last month. The fracas was touched off when an economy cut of $75 million reduced the budget item to $175 million for next year's program. President Eisenhower had originally asked authority to make $250 million worth of grants in 1958. *If the reduction prevails,* federal officials say, new slum-clearance projects will be discouraged, particularly those covering more than 200 acres.

* * *

The 1958 Federal-Aid Program for airport construction and improvement has been announced by the Department of Commerce. Projects at 334 locations have been approved, for which the federal government will contribute $55 million. The construction grants range in size from a $5,325 contribution for runway surfacing in Alamosa, Colo., to million-dollar-plus grants for runways, parking ramps and terminal buildings in at least 14 large metropolitan airports.

* * *

The 13-year National Highway Program cannot possibly be completed in less than 16 years, Federal Highway Administrator Bertram D. Tallamy told a Congressional committee last month. Revenues to which the "pay-as-you-go" plan is limited will not come up to amounts authorized for the 13-year construction period by Congress last session. Mr. Tallamy pointed out that income will provide for the annual apportionments approved for 1957, 1958, and 1959, but thereafter —for ten years—the funds Congress originally hoped for from increased taxes will be less than enough. By 1969, he said, the accumulated deficit would be $5 billion. The Congressmen hearing his testimony quickly changed the subject.

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Bitumuls and Asphalt Put New Life in Famous Ridge Route on U. S. Highway 99

IN JUNE OF 1956, a contract for one of the largest resurfacing jobs to date was let by the State of California Division of Highways. This contract called for more than half a million dollars of resurfacing on a 41 mile stretch of the Ridge Route (U.S. Highway 99) between Los Angeles and the Kern County Line.

Because various types of existing pavements were involved in this project, the requirements for asphalts and Bitumuls to be used in the resurfacing operations were quite complex. For instance, the job called for 21 miles of multi-lane Asphaltic Concrete resurfacing; 13 miles of sub-sealing, crack-sealing, and priming of old rigid-type pavements ahead of resurfacing; 8 miles of sealing and priming of existing bituminous 4-lane roadway; and extensive shoulder work.

To meet these requirements, the quantities of asphalt and Bitumuls required are impressive; for sub-sealing, 1,700 tons of Grade 10-25 Air Refined Asphalt; for resurfacing, 3,500 tons of 200-300 Penetration Paving Asphalt; for seal and prime work, 140,000 gallons of Bitumuls.

Timing and coordination vital

Successful bidder on the job was Schroeder & Co., Sun Valley, California. Completion of the work was scheduled for January 1957, so speed was essential. Also, close coordination was required between the Engineers on the job and the Field Representatives of American Bitumuls & Asphalt Co. (supplier of all bituminous materials) to assure accurate timing and delivery of specific types and quantities of these materials.

On the old rigid-type pavements, slabs were drilled and sub-sealed with Air Refined Asphalt. Cracks and joints were filled and sealed.

Asphaltic Concrete (Paving Asphalt mixed with ½ inch to ¾ inch maximum-size aggregate) was plant mixed and trucked onto the job where it was spread in two lifts, to provide a uniform 3 inch thickness. Using two spreaders equipped with special shoulder extensions, this mix was placed to a full width of 37 feet in a single pass.

The existing bituminous pavement required only a 1 inch overlay of Asphaltic Concrete, as opposed to 3 inches specified over the rigid-type section. Ahead of the placement of this 1 inch thickness, Bitumuls Slurry Seal was used to seal and prime the old surface.

All asphalts from a single source

This job, because of its unusual size and many complexities, provides an excellent example of the ability of American Bitumuls & Asphalt Co. to deliver a full line of asphaltic products to meet every need; and to furnish the on-job field-service that can often mean the difference between profit and loss. Whether your next project is a resurfacing operation or new construction, check with our office nearest you for *all* your asphalt requirements.

BITUMULS SLURRY SEALING ahead of resurfacing on the existing bituminous roadway.

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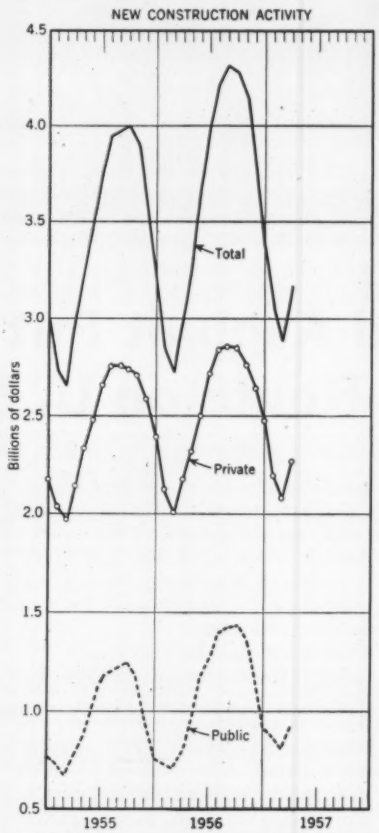
NEWS BRIEFS . . .

Construction Activity in March Advances Seasonally

The value of new construction put in place in March expanded seasonally to $3,172 million, setting a new high for the month and closing out the most active first quarter on record, according to preliminary joint estimates of the Departments of Commerce and Labor. March activity brought the first quarter total to $9,157 million, a 4 percent increase over the previous January-March high in 1956. On a seasonally adjusted basis, new construction activity in the first quarter of 1957 reached the unprecedented annual rate of $44.8 billion, as compared with an annual rate of $44.4 billion in the preceding quarter and actual expenditures of $44.3 billion for last year.

Private expenditures, which accounted for more than 70 percent of all new construction activity during the current January-March period, totaled $6,581 million, slightly above private construction outlays in the previous record first quarter of 1956. Declines in housing, stores, and farm buildings were offset by rises in other types of private construction. Industrial building activity was one-fifth higher than the record level for the first three months of last year. Office buildings, churches, schools, hospitals, and public utilities were also at an all-time high for the period.

Public outlays for construction during the first three months of 1957, at $2,576 million, were 11 percent more than in the corresponding quarter last year, with all major types of construction contributing to the increase. New first-quarter highs were recorded in expenditures for highways, schools, and sewer and water projects.



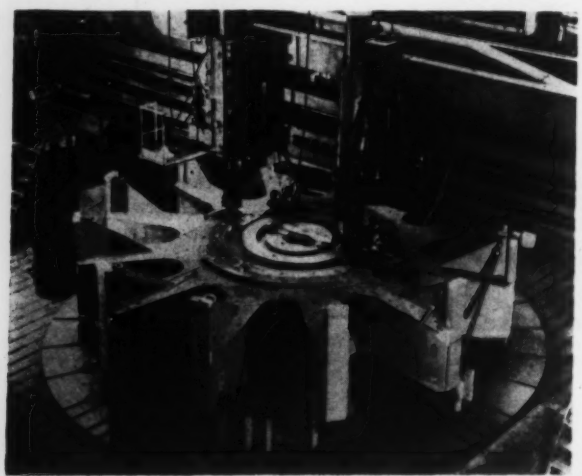
Value of new construction in March, at $3,172 million, sets new high for the month and rounds out the most active first quarter on record.

Public Power Test on Hell's Canyon Rejected

Proponents of public power have lost their legal battle to keep private utility companies from developing the power resources of Hell's Canyon, with the refusal of the Supreme Court early in April to review a decision of the Federal Court of Appeals that the Federal Power Commission license to the Idaho Power Company was valid. In 1953 the Commission granted a fifty-year license to the Idaho Power Company to develop Hell's Canyon, a mile-deep gorge in the Snake River between Oregon and Idaho. As its initial project, the company is already building the first of three low-level dams on the river. It is expected that the project will ultimately supply 1,175,000 kw of power, and that its cost will be in the neighborhood of $250,000,000.

Public power advocates challenging the decision of the Federal Court of Appeals were headed by public utility groups in the state of Washington and supported by both Washington and Oregon. They favor construction of a single high dam as best for the comprehensive development of the site. The State of Idaho submitted a brief in opposition to the public power group.

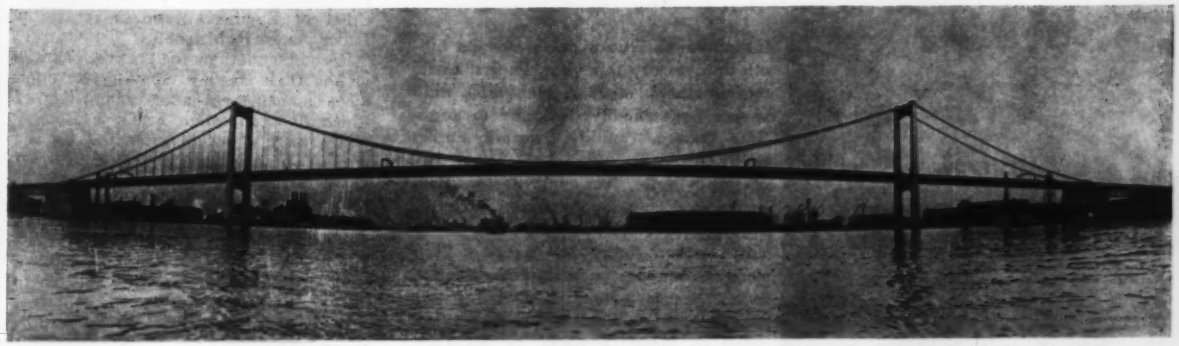
The Hell's Canyon controversy goes back to 1950 when the Corps of Engineers submitted to Congress a proposal for a multi-purpose high dam in Hell's Canyon as a key project in its overall plan for developing the Columbia and its tributaries. The proposed dam would have been 722 ft high, with a reservoir impounding 3,800,000 acre-ft of water and ultimate power capacity of 900,000 kw. It would have been built with federal funds at an estimated cost of $500,000,000.



Rotor for Chief Joseph Dam Generator

This rotor is ready for installation in the ninth waterwheel generator for Chief Joseph Dam, now under construction in the state of Washington as part of the Army's multiple-purpose plan for development of the Columbia River Basin. The East Pittsburgh (Pa.) plant of the Westinghouse Electric Corp. has also built, or else has under construction, all the sixteen initial generators for Chief Joseph Dam. The combined capacity of the units is 1,024,000 kw. The spider in this rotor measures more than 26 ft in diameter and weighs about 40 tons.

Walt Whitman Bridge Uses Record Amount of Aluminum



Walt Whitman Bridge over the Delaware, which will be opened this spring as a new connecting link between the New Jersey and Pennsylvania turnpikes, makes record use (1,000,000 lb) of aluminum in bridge construction. The light metal is used for ten overhead traffic control spans; six overhead sign trusses; 475 aluminum lighting standards; an aluminum grating sidewalk for motorists with car trouble and for routine bridge inspection and maintenance work; and four miles of Alcoa Type A panel railing. In addition almost three miles of Alcoa parapet railing were used for the bridge approaches. The bridge spans 3,500 ft from anchorage to anchorage, with a 2,000-ft center section over the navigable channel. Modjeski & Masters and Ammann & Whitney are the consultants. See article in the February 1956 issue (page 52).

Trinity Dam Contract Let

A joint-venture combination of six companies has been awarded a $48,900,000 Bureau of Reclamation contract for building Trinity Dam in California, according to an announcement from the Department of the Interior. The combination consists of the Guy F. Atkinson Company; M. J. Bevanda; Charles L. Harney, Inc.; the Ostrander Construction Company; A. Teichert & Sons, Inc.; and the Trepte Construction Company. All have headquarters in San Francisco.

The 465-ft-high dam will be an earth and rock structure on the Trinity River about nine miles north of Lewiston. It will be one of the major structures in the Central Valley Project.

Iron Ore Imports Set Record in 1956

The record import of 34 million net tons of iron ore into the United States in 1956 marked an eleven-fold increase in such imports since the end of the war, according to the American Iron and Steel Institute. These imports also represented an increase of almost 30 percent over the former record of 26.3 million tons imported in 1955.

Such gains in ore supplies are largely the result of costly exploration and development programs by American steel and ore companies, particularly in Canada and Latin America. During 1956 more than 45 percent of total iron ore imports came from Canada, and nearly 47 percent came from seven Latin American countries. In all instances, backing from United States companies was a major factor in developing the mining facilities.

The three largest sources were Canada (15.4 million tons), Venezeula (10.4 million tons), and Peru (2 million tons). Four other countries—Brazil, Chile, Liberia, and Sweden—each accounted for more than a million tons.

Plans for further development of foreign ore deposits include additional expansion of mining facilities at Cerro Bolivar and El Pao in Venezuela; development of Peru's Marcona deposit; increased activity in Chile's El Romeral mine; exploration of Brazilian iron ore and manganese deposits; and development of two new iron ore fields in Liberia and the expansion of existing mining facilities. There will also be greatly expanded mining, development, and exploration operations in Canada, particularly in the Steep Rock, Quebec-Labrador, Ungava, Wabush, Mt. Wright, and Marmora regions.

Glen Canyon Dam Bids Opened

Bids for construction of Glen Canyon Dam on the upper Colorado River were opened by the Bureau of Reclamation on April 11. Three bids were submitted: (1) Merritt-Chapman & Scott, New York, $107,955,122; (2) Glen Canyon Construction Co. (a ten-company combination, headed by Guy F. Atkinson, San Francisco), $118,336,476; and (3) Morrison-Knudsen Construction Co., Boise, Idaho (with eight other firms), $120,178,853.

The estimate made by Bureau engineers was $135,608,170. Construction by the prime contractor is expected to start in May, and will continue for seven years.

Glen Canyon Dam is to be of arched gravity section, 700 ft high above bedrock, 560 ft above river level, and will contain about 5,000,000 cu yd of concrete. The reservoir created by the dam will have a capacity of 28,000,000 acre-ft, only 2,000,000 less than the reservoir behind Hoover Dam. Included in the dam contract is an eight-unit power station with a total capacity of 900,000 kw.

The contract for the right diversion tunnel (43 ft in dia) previously had been awarded to a Denver firm of contractors, the Mountain States Construction Co., for $2,452,340 for completion in December 1957. A steel-arch bridge across the canyon just below the dam—under construction by Kiewit-Judson Pacific, Murphy, Emeryville, Calif., at a bid price of $4,139,277— is scheduled for completion early in 1959. Also under construction is a 25-mile $2,000,000 access road from Bitter Springs, Ariz., to the dam site, expected to be in use by July of this year.

The Glen Canyon contract is the most expensive so far awarded by the Bureau. The contract for Hoover Dam, 300 miles downstream, constructed a quarter of a century ago, was for $48,000,000.

Named to have charge of the construction of Glen Canyon Dam is Project Engineer Lenuel F. Wylie, M. ASCE.

Half a Century of Building Trucks

International Trucks celebrates its fiftieth anniversary this year. Its first truck, manufactured in 1907, was this "auto wagon" specifically designed to negotiate rutted, muddy, farm-to-market roads. Its 20-hp, air-cooled engine was of two-cylinder, four-cycle design. Recommended top speed was 20 mph. Through 1915 all models were right-hand drive. Today International Harvester produces a complete line of motor trucks — from 4,200-lb pickup models to giant off-highway haulers rated at 96,000 lb GVW. In the 1907-1957 period its output has been 2,610,441 trucks.

Associated General Contractors Meet in Washington

Senator William Knowland, minority leader in the Senate, outlined the dangers facing the United States in an address opening the 38th annual convention of the Associated General Contractors of America, held in Washington, March 11-14. Senator Knowland told the nation's leading contractors that "the strength of our country depends, of course, on far more than our armed forces alone. It rests upon a sound national economy and a solvent federal government."

Praising the group for its "concern with our free enterprise system and with the sound expansion of our national economy," he urged the contractors to take an active part against inflationary trends in the government. "I believe," he said, "that government spending has been and remains one of the major inflationary factors in the country today. Continuous inflationary pressures could lead to demands for price controls which in turn would result in controls over wages, profits after taxes, and might very well require the allocation of both manpower and materials." If we ever let our economy slip under such controls in peacetime, he emphasized, we may not get out from under them again in our lifetime.

Mr. Knowland also scored isolationism, saying that "in this day of the airplane and the atomic weapon, we can no more return to isolationism than an adult can return to childhood, regardless of how pleasant the recollection may be."

In another leading talk Bertram D. Tallamy, M. ASCE, Federal Highway Adminstrator, reported finding the state highway departments "gratifyingly alert" to the problems involved in getting the new highway program under way and "knee-deep in all types of solutions to the current deficiencies that we have." With all the good will in the world on the part of suppliers of materials, he said, there may be shortages and there may be delays in deliveries, and warned the group that they must make allowances for this by careful planning and scheduling and—if need be—by finding alternates and substitutes.

Mr. Tallamy also reminded the contractors that, "This is the first time we have had long-range financing. That makes it possible for us to do long-range scheduling, and it is exceedingly important to us who are in the planning field to make certain that our plans are produced in sufficient time to obligate the funds which come into the trust fund." He pointed out that it is the intent of the highway program "to have small contracts as well as big ones," and remarked that "there will be ample opportunity for new contracting organizations to enter the field."

Dr. Henry H. Armsby, Chief for Engineering Education in the U. S. Office of Education, outlined the engineering manpower situation. He said that he cannot foresee any possibility of a surplus of engineers. In connection with recruiting into the profession, Dr. Armsby remarked that there are some 16,000 science clubs now active in the United States, and that it would be as easy, as it is necessary, to get these young people thinking about careers in science and engineering.

Among other featured speakers were Leon Chatelain, Jr., president of the American Institute of Architects; W. A. Dexheimer, M. ASCE, U. S. Commissioner of Reclamation; Maj. Gen. J. S. Bragdon, Special Assistant to the President on Public Works Planning; Rear Admiral Robert H. Meade, chief of the Bureau of Yards and Docks; Maj. Gen. Emerson C. Itschner, M. ASCE, U. S. Chief of Engineers; and Secretary of Labor James P. Mitchell.

Recommendations for possible changes in the Taft-Hartley Act—agreed upon by a management-labor committee, of which AGC President Frank J. Rooney was a member—were supported by the group. These include amending the act (1) to permit the National Labor Relations Board to certify collective bargaining agreements in the building and construction industry without the necessity of election where there is a historical background of bargaining, and (2) to clearly recognize the rights of employers in the construction industry to bargain on an association basis.

In line with Senator Knowland's talk stressing the dangers of inflation, the convention also passed a resolution recommending to both the employer and labor representatives of collective bargaining groups in the industry that wages and other labor benefits negotiated "be reasonably related to improvement in productivity and the cost of living."

New Headquarters for the AGC

During the meeting final authorization for beginning construction on the new AGC headquarters building was given, and President Frank Rooney turned up the first shovelful of dirt in ground-breaking ceremonies. The AGC, which has had its headquarters in the Munsey Building throughout its history, began last year to plan for a building of its own to provide more space for its growing requirements. It will be completed in about a year.

New Officers Installed

At the close of the meeting Lester C. Rogers, M. ASCE, president of Bates and Rogers, Chicago, succeeded Mr. Rooney as president. Fred W. Heldenfels, Jr., of Heldenfels Brothers, Corpus Christi, Tex., was installed as vice-president. James D. Marshall, of Washington, D. C., is executive director.

Two Nike Sites to Be Built in Alaska

Two contracts for construction of the first Army Nike guided missile sites in Alaska have been awarded by the Alaska District of the Corps of Engineers. Peter Kiewit Sons' Company, of Seattle, Wash., received an $11,842,238 contract for construction of Nike installations in the Eielson Air Force Base area near Fairbanks. The other contract, amounting to $9,495,744, went to the joint venture of Patti-MacDonald and the M-B Contracting Company, of St. Louis, Mo., for construction of Nike sites in the Fort Richardson area.

AIME Reorganizes As Three Societies

With the aim of improving service to its members, the American Institute of Mining, Metallurgical and Petroleum Engineers, at its annual meeting in New Orleans, February 24-28, reorganized its structure to transform its three Branches into the Metallurgical Society of AIME, the Society of Mining Engineers of AIME, and the Society of Petroleum Engineers of AIME. The new setup, long under consideration and now approved by the board of directors, places the 30,000 members in the new societies according to individual member choice. The board of directors of the Institute continues in control. Each society, in rotation, is to name the AIME president for a year.

AIME headquarters are in New York, as are the offices of the metallurgical and mining organizations. Dallas, Tex., is the headquarters of the petroleum society.

Disposal of Solid Waste Studied on National Scale

The pressing need for engineering studies to collect, analyze, and evaluate basic data on the collection and disposal of refuse, garbage, and other wastes was voiced at a two-day conference on the problems of community solid waste, held in Washington, March 14 and 15. Problems requiring research and academic training also received attention. Along with consideration of technical aspects of the field, the conference pointed up the need for increasing the awareness of both the general public and local officials of the problems involved in the adequate and sanitary disposal of solid wastes.

The Public Health Service served as host to the conference, which was the first meeting of its kind to consider such problems from a national perspective. About twenty outstanding engineers, scientists, academicians, and administrators met to develop recommendations and courses of action aimed at solving the problems involved in the collection and disposal of solid wastes in communities throughout the nation. ASCE was represented by Morris H. Klegerman, owner of the New York firm of Alexander Potter Associates.

Most of the two-day meeting was devoted to the deliberations of three *ad hoc* Task Study Groups, one each on collection, disposal, and the administration, training, and other aspects of community waste problems. Each group considered the identification of problems, adequacy of current practice, unmet needs, and possible action programs.

New Andes Power Project to Supply Peru Refinery

Water from the turbulent Paucartambo River, which has its source in lakes high in the Peruvian Andes, was formally harnessed on March 17 when the United States-owned Cerro de Pasco Corporation dedicated its $31,000,000 hydroelectric project. The new project, which generates enough energy to light a city of half a million people, will provide 65,000 kw of power for the corporation's copper, lead, and zinc refineries at La Oroya. With the addition of two generators, capacity can be stepped up to 100,000 kw.

Of recent years operations of the Cerro de Pasco Corporation have been seriously curtailed by drought. Opening of the Paucartambo plant, which is on a different watershed from the corporation's other four plants, is expected to relieve this power shortage. With it the corporation will have 138,000 kw of installed capacity.

Water for the project is dammed at a site in the Paucartambo Valley known as Yuncan. From this headworks it is diverted into an eight-mile-long tunnel, bored through the mountains more or less parallel to the river, and discharged down a 3,800-ft-long steel penstock to the power station at river level 1,500 ft below. The power generated is conveyed to the smelting and refining center at Oroya by means of an 89-mile, 138,000-v transmission line.

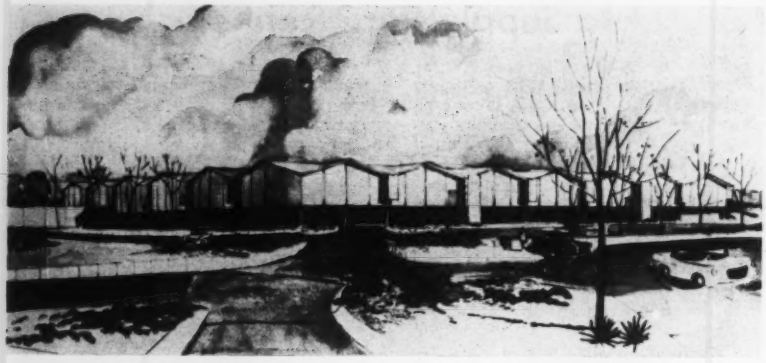
More than five years in construction, the Paucartambo plant is one of the largest and most modern in South America. It is also one of the most remote, being located in virgin territory, once accessible only by mule and llama train. Before the project could be undertaken it was necessary to build a 60-mile $5,000,000 access road. Much of the access road was built at an elevation of over 15,000 ft. In some instances it had to be carved out of cliffs of solid rock, with workmen lowered to the site by means of ropes. At times as many as 3,000 workmen were employed on road construction.

Ebasco Services, Inc., of New York, furnished the design and resident engineers for the project.

At the outlet of the eight-mile-long tunnel water enters the 3,800-ft penstock (7 ft in outside diameter), which conducts it to the Yaupi Bajo powerhouse 1,500 ft below. In the inset is a view of the powerhouse from an inclined railway (powered by a 250-hp hoist) paralleling the penstock.

Interior view of the powerhouse is shown here. The plant houses three turbine-generators, each rated at 24,000 kva. With development of a relatively small additional storage area, it will be possible later to add two more generating units.

Solar Device Breaks Ground for Texas Instrument Plant



At ceremonies highlighted by use of a solar converter-transistor-blaster device for breaking ground, Texas Instruments, Inc., started construction on February 26 of a new $4,000,000 plant in Dallas, which will provide 280,000 sq ft of space for its Semiconductor-Components Division. The new plant will represent the first industrial application in the United States of hyperbolic paraboloid thin-shell prestressed concrete construction. The thin-shell ceilings, suggesting an "inside-out" umbrella, are designed to give occupants a feeling of spaciousness and calm because of their great span and sound-diffusing qualities. The sunshade shape is repeated in each room unit, with utilities carried through the central column. Completion and occupancy of various sections are scheduled to begin in October and extend until April 1958. Building architects were O'Neil Ford and Richard Colley. Consulting engineer was Thermotank, Inc. Detroit; electrical design consultant, Ebasco Services, New York; and site engineering, by Hundley & Halff, Dallas. Construction is in the hands of Robert E. McKee General Contractor, Inc.

Register of Large Dams in U. S. in Preparation

Vital data on important dams in the United States are being assembled and published by the U. S. Committee on Large Dams of the International Commission on Large Dams. This valuable new reference, to be known as the "Register of Dams in the United States," will contain the names, dimensions, and other salient facts on our major dams. The names of the owner of the dam, the engineering firm responsible for its design, and the construction contractor will be included. There will also be photographs of the more important structures.

The need for such a reference has long been felt, since most of the pertinent information is scattered all over the United States in the records of the participating engineering firms, contractors, and state and federal organizations. With the new compilation anyone seeking information about a dam will have it at his fingertips. The reference will also serve to bring recognition to the many designing, engineering, and contracting firms engaged in dam construction.

Height alone will not be the primary consideration in determining whether or not a structure is included in the register. While some dams are not outstanding in point of size, they incorporate interesting and complicated engineering features that make them of wide interest. Dams with a structural height of only 50 ft could fall into this category. No attempt will be made to list the many smaller projects, which do not impound any considerable storage.

To aid in preparing the register, owners, engineering firms, and contractors are urged to contribute data on structures with which they are connected in one capacity or another. Necessary forms for recording the data may be obtained from T. W. Mermel, Chairman of the Committee on the Register of Dams, 4540 43rd Street, N.W., Washington 16, D. C. The register will be published early in 1958.

The U. S. Committee on Large Dams is a member of the International Commission on Large Dams of the World Power Conference, which has for its aim the encouragement of improvement in design, construction, maintenance, and operation of large dams by compiling information on them and studying questions relating to them. The U. S. Committee is under the chairmanship of ASCE Vice-President Francis S. Friel, of the firm of Albright & Friel, Inc., Philadelphia. The U. S. Committee will be host to the Sixth Congress on Large Dams, to be held in New York in September 1958.

Awards Offered for Welded Bridge Designs

A new bridge design competition, offering a total of $50,000 in awards for designs of welded highway bridges, is announced by the James F. Lincoln Arc Welding Foundation. A total of sixteen awards will be made, with a top award of $10,000, for the best designs for highway bridges, which are or could become a part of the National System of Interstate and Defense Highways. Any type of structure, either proposed or built, may be submitted so long as it conforms to the general requirements of the system. Designs will be judged on quality of detail, economy in material and labor, cost savings, and appearance.

The new competition, the fourth in a series sponsored by the Foundation, is open to all residents of the United States or its possessions. Information on the preparation of entries may be obtained from the James F. Lincoln Arc Welding Foundation, Cleveland 17, Ohio.

February Housing Starts At Lowest Since 1949

Nonfarm housing starts failed to show the usual seasonal upturn in February 1957 and remained at the January total of 65,000 units, according to the U. S. Department of Labor's Bureau of Labor Statistics. This was down 17 percent from a year ago and was the lowest February figure since 1949.

The 62,500 private houses and apartments begun this February represented a seasonally adjusted annual rate of 910,000 units, marking the first time since December 1951 that the seasonally adjusted annual rate of private housing starts dropped below 1,000,000. About 2,500 units of new public housing were reported for the month—slightly less than in January.

In the first two months of 1957, a total of 130,000 dwelling units were

placed under construction, or 15 percent less than the 153,300 begun in the same period of 1956.

Preliminary building-permit reports indicated January-to-February gains in the amount of new housing authorized in the Northeast and North Central regions, but volume was off in the South and showed little change over the month in the West. A year ago building-permit authorizations rose from January to February in all four regions.

Kaiser Steel Plans Increase in Capacity

Plans for increasing its current $113,000,000 expansion program by an additional $81,000,000 are announced by the Kaiser Steel Corporation. The entire program, which now totals $194,000,000, will increase the company's annual ingot capacity from 1,536,000 tons to approximately 3,000,000 tons. In terms of finished products the principal increases will be in plate, sheet, tin plate and pipe—products that are in greatest demand in the West.

The $81,000,000 expansion will increase the facilities of Kaiser's Fontana plant by 90 new coke ovens and a new blast furnace. It will also provide for improvements at the company's Eagle Mountain, Calif., iron ore mine and at its coal mines in Utah and New Mexico. The new blast furnace to be built at Fontana, the only fully integrated steel plant on the West Coast, will increase hot metal (pig iron) production to a total of 2,121,000 tons a year.

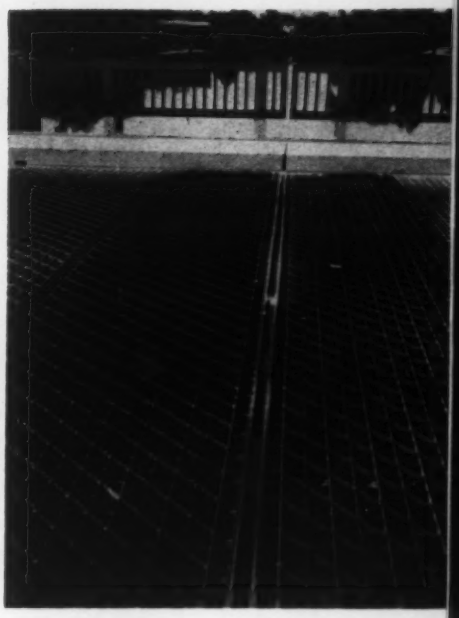
Water Pollution Control In U.S. Possessions

Plans for more sewage treatment plants in Hawaii, Puerto Rico, and the Virgin Islands have been announced by the U. S. Public Health Service. The plans were prepared by engineers of the Service's Water Supply and Water Pollution Control Program in cooperation with the Islands' health departments.

Hawaii's pollution control needs include additions to existing plants or new plants and sewer systems for 18 districts in the territory. The Puerto Rico plan names 75 cities and towns needing additions, replacements, or new treatment works. In the Virgin Islands new plants are needed at Charlotte Amalie, St. Thomas; Cruz Bay, St. John; and Christiansted and Frederiksted, St. Croix.

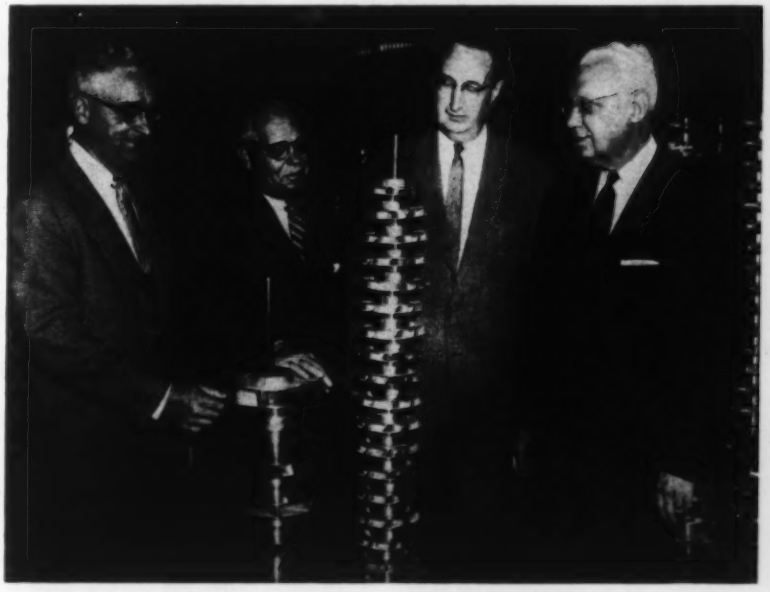
The work will go forward under the provisions of the new Water Pollution Control Act authorizing up to $50 million a year to help communities build sewage treatment works.

Louisiana Bridge Employs Non-Skid Grating



Bascule bridge at New Iberia, La., uses specially designed non-skid grating. Serrated surface and radial grid members tend to check skidding in all directions. Main bearing bars were spaced at 7½ in. to minimize welding operations, and units were fabricated at a width of 7 ft 3 in. Bridge designer was J. B. Carter, and the contractor F. Miller & Sons. The grating was fabricated by the Kerrigan Iron Works, Bridge Flooring Division, Nashville, Tenn.

Layne & Bowler, Inc., Celebrates 75th Anniversary



For 75 years Layne & Bowler, Inc., Memphis, Tenn., has been making pumps. The first ones, tried out in the Dakota Territory, lifted water out of dug wells. These have since been replaced by multi-stage deep well pumps installed in steel casings perforated and protected with gravel packing against entrance of sand. Shown here are four top officers of Layne & Bowler, Inc., inspecting newly made pump impellers. They are L. G. Ost, secretary-treasurer; A. O. Fabrin, vice-president of engineering; Frank T. Quinn, A. M. ASCE, vice-president of manufacturing; and William H. Reeves, president. Main offices and factory are in Memphis, Tenn., but associate companies have been established all over the world.

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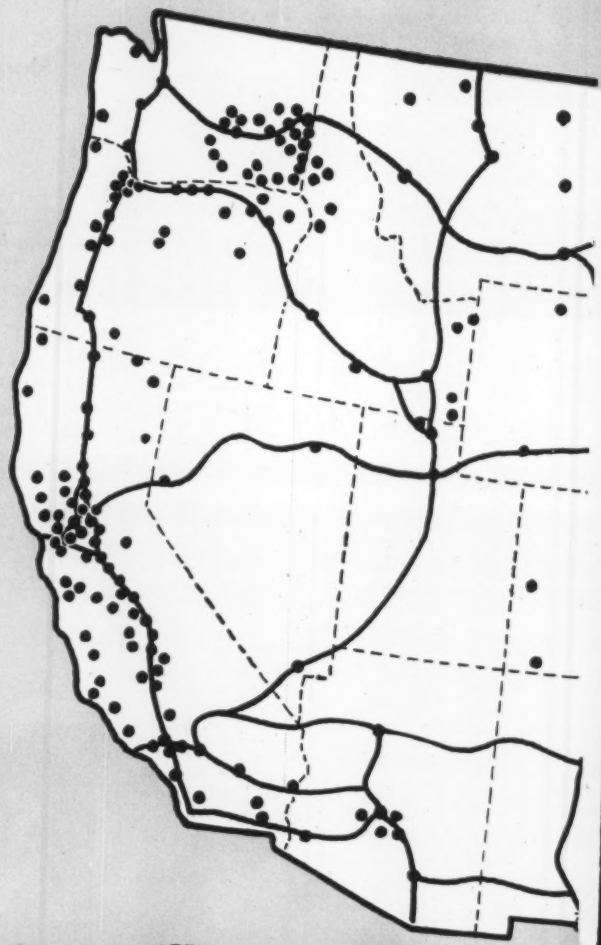
To concentrate the capabilities, resources and experience of our people and of the world-wide Caterpillar dealer organization on the design, manufacture, distribution and service of job tested heavy equipment.
CATERPILLAR TRACTOR CO



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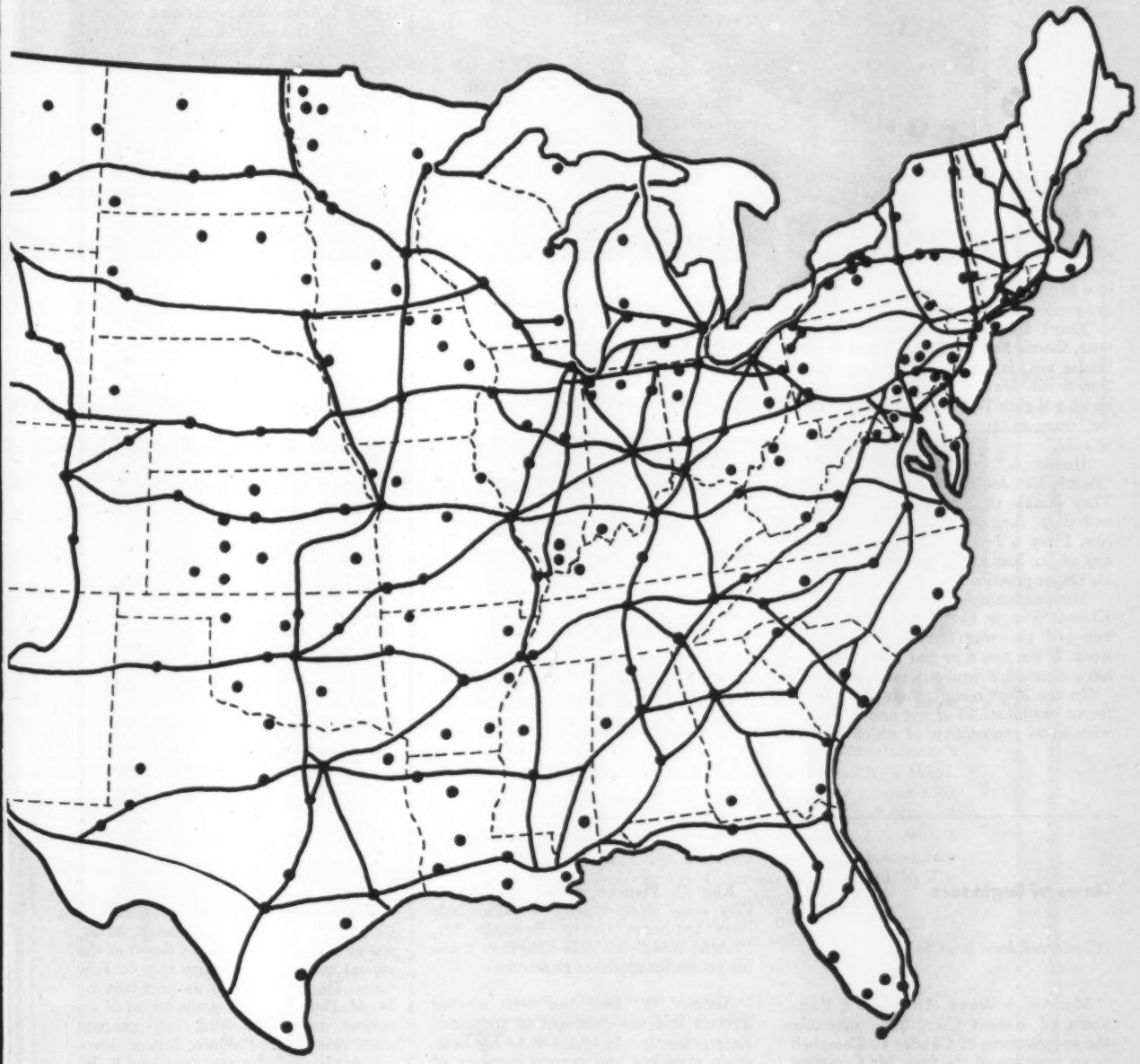


ONE GOAL... To concentrate the capabilities, resources and experience of our people and of the world-wide Caterpillar Dealer organization on the design, manufacture, distribution and service of job-tested heavy equipment....

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

N. G. Neare's COLUMN

"Is it going to hail next Sunday, Joe?"

"Probably not, Professor. Why?" asked Joe Kerr.

"I was just establishing the fact that you're a weather prophet. Now you can answer this month's question. How often in a 37-yr record will there be 7 or more dry years in succession?"

"Easy! By your definition of a dry year, there's half a chance that any particular year is dry, so 1/128 chance that 7 in a row are dry. In 37 yr, there can be only 4 such 7-yr periods separated by wet years, so the chance is 4 times 1/128, or 1/32."

"Hmmmph," sneered Otto Mayshen. "People like Joe should shun Las Vegas. They double their bets after every loss and drop their rolls on 7 blacks in a row. I say a 7-yr period can start with any of the first 31 yr, making the chance 31/128, or practically one fourth."

"Hmmmphmmph," double-sneered Cal Klater. "People like Otto wouldn't bet two and two wasn't five seven days a week. If the first 8 yr had been dry, he'd have counted 2 droughts instead of one.

"In the 37-yr record, there are 2^{37} different combinations of wet and dry years with equal probability, of which 2^{29} end with WDDDDDDD, recording that many new droughts. Also, any drought recorded in the first 36 yr would be counted twice in the 37-yr combinations —once if the 37th year was wet and once if it was dry. Hence, if p_n is the probability of a drought of 7 or more years in an n-yr record,

$$p_{37}.2^{37} = p_{36}.2^{36}.2 + 2^{29}$$

$$p_{37} = p_{36} + \frac{1}{256}$$

"That derivation is general, making a convenient addition formula for any record longer than 7 yr, so we can start with Joe's

$p_7 = 1/128$

and add the additional increment 30 times to find

$$p_{37} = \frac{1}{128} + 30.\frac{1}{256} = \frac{1}{8}$$

so that there is only one chance in eight of such a drought in a 37-yr record."

"And maybe 2 chances out of 3 that weather prophets are wrong," added Professor Neare, "and a near certainty that none of them get rich at Las Vegas. If you don't believe Cal's answer, just write out the 2^{37} combinations and count the droughts. Try it on your univac.

"And while you're all excited about droughts, here's a sequel that can be unravelled by a corollary. Limiting ourselves now to exact 7-yr droughts like the biblical '7 lean years' (preceded and followed by fat years or end of record), how often will one occur in a 68-yr record?"

[*Pending adjustment to new deadlines, acknowledgments are deferred one month. Additional solutions to the February analogue problem were contributed by Ed C. Holt Jr., and Thatchrite (Guy C. Thatcher).*]

News of Engineers

(Continued from page 26)

Marshall & Brown, Architects & Engineers, of Kansas City, Mo., announce the appointment of **Charles C. Campbell** as an associate of the firm. Mr. Campbell was previously an engineer with the firm.

Woodward, Clyde & Associates, Oakland, Calif., recently opened midwest branch offices in Omaha, Nebr., and Kansas City, Mo. The Omaha office is under **Howard M. McMaster,** former professor of soil mechanics at the University of Nebraska, and the Kansas City office is temporarily headed by **James L. Sherard,** widely recognized for his work on earth filled dams. The Denver branch is under **William A. Clevenger,** formerly with the Bureau of Reclamation.

Kurt O. Planche is the new Kansas City sales representative of Allis-Chalmers Industries Group. Recently Mr. Planche completed Allis-Chalmers training course for graduate engineers.

Andrew W. Day has been elected director and vice-president of Industrial Enterprises, Inc. In addition, he has been made president and general manager of Industrial's Vincennes Steel Division. Mr. Day joined Vincennes Steel as an engineer in 1916.

Arthur M. Field, chief engineer of the Charleston, S. C., Development Board, recently became a member of the Advisory Council of South Carolina's Employment Security Council. He will serve as employers' representative.

Harold F. Redmile, since 1935 field project manager for the E. I. du Pont de Nemours Company, will serve in this capacity on construction of the company's new plant near Brevard, N. C. Until recently Mr. Redmile was with du Pont at Antioch, Calif.

Emil J. Kaleschke, supervising civil engineer of Oakland, Calif., retired on April 1, after 33 years in the Oakland City Engineer's Office. During Mr. Kaleschke's long tenure in municipal service he has been office engineer, designing draftsman, assistant civil engineer, senior engineer and supervising engineer. He played a leading part in the formation of the Northern California Chapter of the American Public Works Association. His fellow employees honored him with a large farewell dinner.

Emil J. Kaleschke

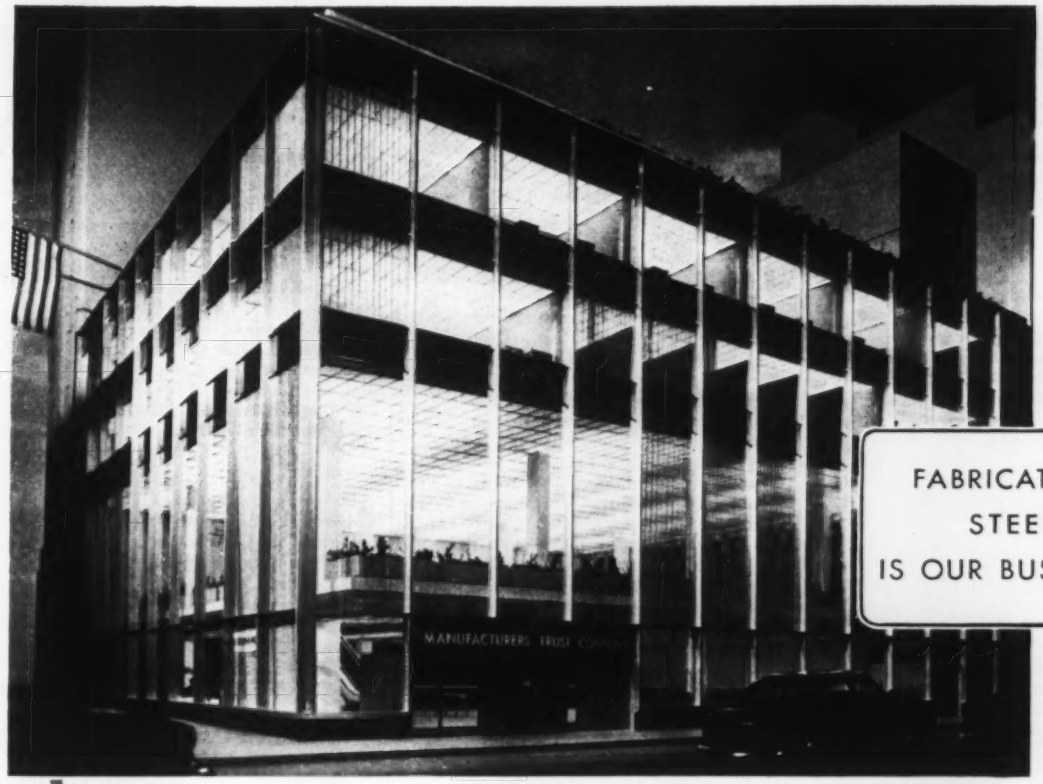
Paul O. Roberts, Jr., of Atlanta, Ga., has been named first prize winner of the 1957 Bausch & Lomb Photogrammetric Award for his paper entitled "Using New Methods in Highway Location." The prize consists of $100 and a three-year membership in the American Society of Photogrammetry. Mr. Roberts holds a B.S. degree from Texas A & M College and is currently a graduate student in civil engineering at Massachusetts Institute of Technology.

Paul O. Roberts, Jr.

W. F. Uhl, since 1941 president of Charles T. Main, Inc., of Boston, Mass., was elected chairman of the board at the annual meeting of the firm held in February. He is succeeded as president by **W. M. Hall,** member of the board of directors since 1943 and vice-president since 1953. **R. T. Colburn,** former director, was elected vice-president, and **R. W. Logan** was reelected treasurer.

Ben E. Nutter, former superintendent of public works, territorial highway engineer, and chairman of the Board of Harbor Commissioners for the Territory of Hawaii, has joined the Port of Oakland, Calif., as chief engineer. The port has underway a $15,000,000 expansion of the Metropolitan Oakland International Airport.

(Continued on page 100)



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(Continued from page 98)

Ralph L. Pfau, Captain, U. S. Coast and Geodetic Survey, retired on April 1 after almost 33 years in the Survey. From 1953 until his retirement he was in Washington, D. C., as assistant chief of the Geophysics Division and, later, the Geodesy Division. Earlier he was Kansas City District Officer.

Francis H. Falkner, Colonel, Army Corps of Engineers (retired), has been appointed chief engineer of the Los Angeles office of Porter, Urquhart, McCreary & O'Brien, consulting engineers. In his new position with Porter, Urquhart, McCreary & O'Brien, he will continue to devote himself to military construction and water resource development.

Bradford N. Clark, civil engineer and administrative partner in the architectural firm of Eggers and Higgins, New York City, recently was elected president of the New York City Post of the Society of American Military Engineers.

Berne Martin Howard, bridge engineer for the Spokane, Portland and Seattle Railway Company, Portland, Ore., retired in March after nearly forty-five years of service. Mr. Howard is a past president of the Oregon Section of the Society.

Ross H. Bryan, consulting engineer of Nashville, Tenn., has moved his offices from the Nashville Trust Building to the Life and Casualty Tower.

Gurney H. Dayett, Sr., has retired as assistant to the chief engineer of the Baltimore & Ohio Railroad, Baltimore, Md. Mr. Dayett was with the Baltimore and Ohio from 1922 on and had been assistant to the chief engineer since 1955. He is a former president of the Maryland Section of the Society. Other recent changes in the engineering department include the promotion of **Henry Seitz,** former designing engineer of bridges and buildings, to the post of structural engineer.

Fred N. Severud, Eivind G. Elstad, and **Max Krueger** have added fourteen associates to the firm and announce a change in the firm name from Severud-Elstad-Krueger to Severud-Elstad-Krueger-Associates, with offices continuing at 415 Lexington Ave., New York City.

Ira T. Sanders, Captain, U. S. Coast and Geodetic Survey, and assistant to the director, Washington, D. C., retired in March after more than 32 years of service. Upon his retirement he was advanced to the rank of Rear Admiral because of special commendations by the Secretary of the Navy "for the performance of meritorious service in combat during World War II."

DECEASED

Kenneth Allen Augason (J.M. '55), age 25, Second Lieutenant with the U.S. Air Force, was killed in a jet collision on January 24. Mr. Augason graduated from the University of Utah in 1955. Before entering the service, he was connected with the Chicago Bridge and Iron Co., Salt Lake City, Utah. His home was in Salt Lake City.

Frederick Lee Browne (A.M. '40), age 48, chief of the Concrete Branch, Materials Testing Laboratory, North Pacific Division of the Corps of Engineers, died in Portland, Ore., on December 29. A graduate of Purdue University in 1932 with a civil engineering degree, Mr. Browne received a master's degree in architecture from Catholic University and did graduate work in engineering at Cornell University. After several years with the U. S. Forest Service, Mr. Browne spent the remainder of his career in the Corps of Engineers. During World War II, he served as an officer in the Pacific theater.

Mack Galbreath (M. '53), age 69, special consultant to the Kentucky Highway Commissioner, died suddenly of a heart attack at his home in Frankfort, Ky., on March 9. After forty years with the U.S. Bureau of Public Roads, Mr. Galbreath retired in 1956 from his position as district engineer in Kentucky. He became connected with the Bureau shortly after his graduation from the University of Missouri in 1912. Mr. Galbreath worked on the surveying and construction of the first Federal Highway in Kentucky (now Ky. 11).

Daniel E. Garey (M. '50), age 55, vice-president and chief structural engineer with Graham, Anderson, Probst and White, Inc., architects and engineers, Chicago, died on January 27, in Hinsdale, Ill. He had directed the structural design for a large volume of public and private work, including U.S. Navy ammunition plants at Hastings, Nebr., Shumaker, Ark., and Seal Beach, Calif.; the Atomic Energy Plant at Richland, Wash.; the Columbia Steel Company Plant at Provo, Utah; and the Electrical Engineering and Chemistry Buildings at the University of Illinois. Mr. Garey was a graduate of the University of Kentucky.

David S. Gendell, Jr. (M. '17, age 79, retired general manager of erection for the Bethlehem Steel Company, died at his home in Bethlehem, Pa., on March 16. Mr. Gendell had been connected with the Bethlehem Steel Company and its predecessor, the McClintic-Marshall Co., throughout his career. From 1903 to 1919 he was manager of erection for McClintic-Marshall; from 1919 to 1925 assistant manager of the Pottstown Plant; and from 1925 to 1930 manager of erection for the New York district of McClintic-Marshall. He supervised the steel construction of many important buildings and bridges.

Winfield Holbrook (A.M. '10), age 77, vice-president and treasurer for the Texas Land and Development Company, Plainview, Tex., died recently. Mr. Holbrook had been connected with the company since 1919. Earlier he was resident engineer on dam construction and chief engineer for the Beaver Park Land and Water Company, Colorado, and superintendent of the U. S. Irrigation Company, Kansas. Mr. Holbrook graduated from the University of Colorado in 1904 with a B.S. degree in civil engineering.

Herbert Weymouth McCord (A.M. '36), age 53, sales engineer for the Ingalls Iron Works Company, New York, N. Y., died on February 24. He had been connected with the company since 1932, and earlier was superintendent of erection for Post and McCord, of New York. He graduated from Lehigh University in 1927 as a civil engineer.

Clyde Myers (M. '35), age 72, retired civil engineer of Phoenix, Ariz., died in a hospital there on February 4. From 1928 to 1947 Mr. Myers headed the engineering department at Phoenix College. From the latter year until his retirement in 1956 he was with the City of Phoenix on traffic safety engineering; project engineer for the State of Arizona on traffic surveys; and in the Maricopa County right-of-way department. He received an arts degree from Washington State College in 1909, and science and engineering degrees from the same college later. Mr. Myers was active in the Arizona Section, which he served as president in 1938. He was a World War I veteran and active in the Reserve.

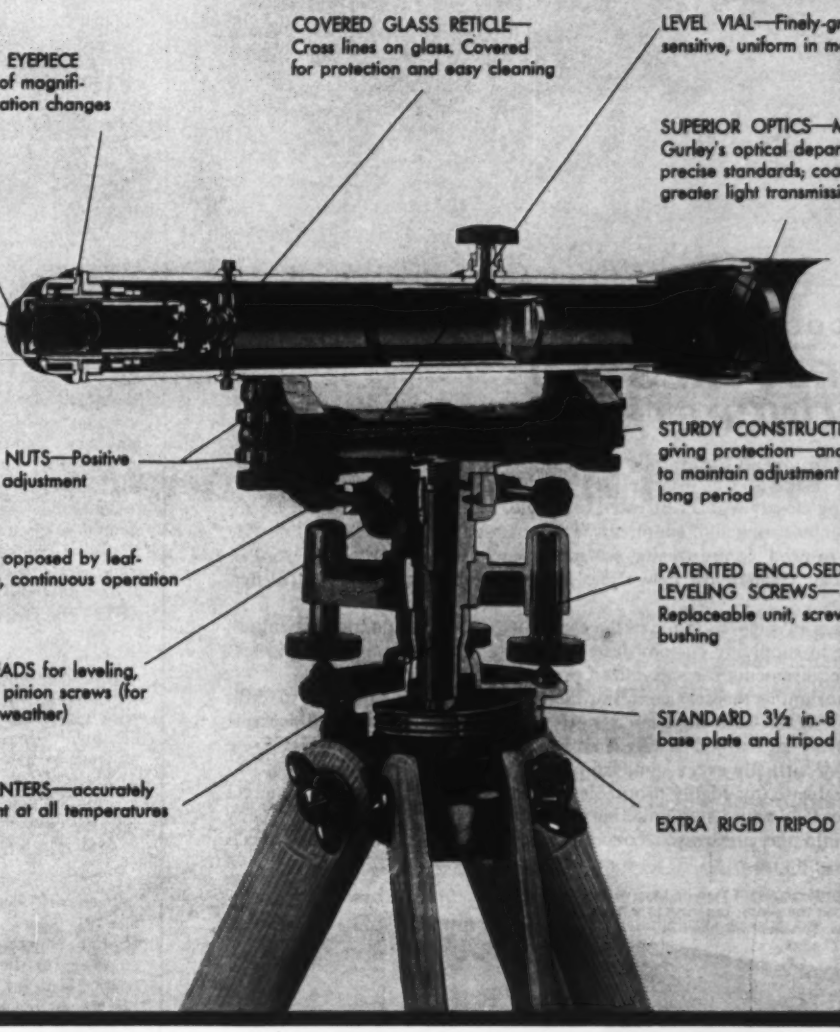
Ernest Nicholson (A.M. '23), age 71, engineer and underwriter for the Aetna Casualty and Surety Co., New York, N. Y., died there on February 20. Mr. Nicholson had been connected with Aetna Casualty since 1925, when he became field engineer on surety bonds for the company at Hartford, Conn. His earlier experience included two years in charge of construction in the field in the New England States and New York State for the Standard Oil Company of New York, and three years in the field for Babcock & Wilcox. He was a World War I veteran, and graduate of Virginia Polytechnic Institute and Massachusetts Institute of Technology.

William Henry Phelps (J.M. '52), age 29, contractor (for the army) with the firm of H. Phelps and Son, Jackson,

(Continued on page 102)

The Gurley Engineers Level

Wye or Dumpy Types


VARIABLE POWER EYEPIECE
Permits adjustment of magnification when illumination changes
NON-METALLIC EYEPIECE CAP (for comfort in extreme weather)
HAZE FILTER—Improved image contrast under nearly all light conditions
LEVEL ADJUSTING NUTS—Positive opposing nuts hold adjustment
TANGENT SCREW opposed by leaf-type spring; smooth, continuous operation
NON-METALLIC HEADS for leveling, tangent, clamp and pinion screws (for comfort in extreme weather)
LONG TAPERED CENTERS—accurately fitted, free movement at all temperatures
COVERED GLASS RETICLE—Cross lines on glass. Covered for protection and easy cleaning
LEVEL VIAL—Finely-ground, sensitive, uniform in movement
SUPERIOR OPTICS—Made in Gurley's optical department to precise standards; coated for greater light transmission
STURDY CONSTRUCTION giving protection—and rigidity to maintain adjustment over a long period
PATENTED ENCLOSED LEVELING SCREWS—Replaceable unit, screw and bushing
STANDARD 3½ in.-8 thread base plate and tripod head
EXTRA RIGID TRIPOD

Model 372 Dumpy Level

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PRESTRESSED CONCRETE ROOF GIRDERS

for **American Cyanamid's** new phosphate storage warehouse

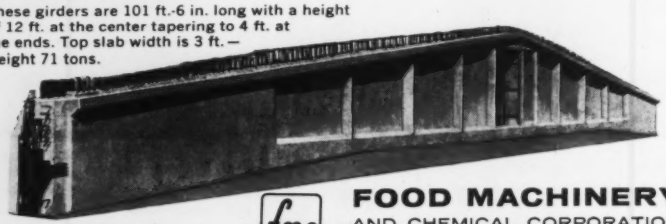
Working closely with Prestressed Concrete, Inc., Florida Division's Form-Crete engineering staff supplied special mass-production steel casting side forms to produce prestressed concrete griders for supporting the roof of American Cyanamid's new triple phosphate storage plant at Brewster, Florida.

This is a typical example of the capability of our Form-Crete consultant service in supplying custom designed and fabricated steel forms to meet your requirements for specialized projects.

Important as this service is, our main objective is the supplying of skillfully designed and engineered steel poured-in place and semi-portable side forms for flat bed casting. Fabricated to order, there is a Form-Crete form for virtually every standard prestressed concrete product.

Investigate this highly profitable new market—the prestressed concrete product field with its unlimited applications... write, wire or phone today—get into the prestressed concrete business now with FORM-CRETE steel casting forms!

These girders are 101 ft.-6 in. long with a height of 12 ft. at the center tapering to 4 ft. at the ends. Top slab width is 3 ft.—weight 71 tons.



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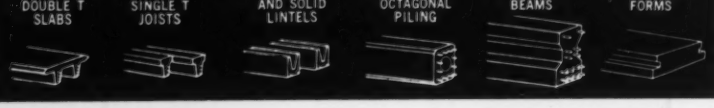
PF-8

FORM-CRETE STEEL FORMS FOR CASTING REINFORCED OR PRESTRESSED CONCRETE



Deceased

(Continued from page 100)

Mich., died recently. Mr. Phelps graduated from Michigan State College in 1952 with the B.S. degree. Since then he had been with H. Phelps and Son on heavy construction work.

Alden Gallup Roach (M. '40), age 56, president of the Consolidated-Western Steel Corp., Los Angeles, Calif., died recently. Mr. Roach became connected with the Consolidated Steel Corporation in 1929, and was made construction engineer in 1930 and vice-president in 1935. In 1938 he was elected executive vice-president and director of all operations. Later when U. S. Steel bought Consolidated and changed its name to the Consolidated-Western Steel Company, he became president. He was an engineering graduate of the University of Illinois.

William J. Schlick (M. '20), age 70, professor of civil engineering at Iowa State College, Ames, Iowa, died on February 5. In his 43 years as a staff member at Iowa State, Professor Schlick was active in research, teaching, and administration. His assignments included a period as assistant director of the Engineering Experiment Station. He did pioneer work in hydrology and drainage, and one of his early Experiment Station bulletins on land drainage is still considered a classic in the field. Some of Professor Schlick's many other publications dealt with underground conduits and pipe loads. He worked on many ASTM committees.

Irven Clarence Shafer (A.M. '28), age 58, partner in the firm of Shafer & Kline, Overland Park, Kans., died at his home there on February 21. For nineteen years Mr. Shafer was connected with the Kansas State Highway Commission, which he had served as associate engineer and as resident engineer at Manhattan and Wichita.

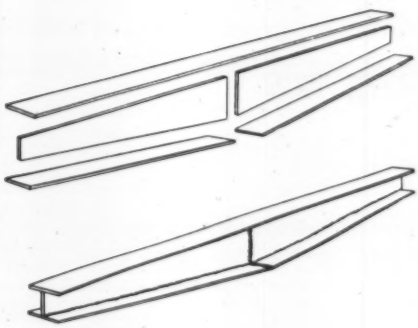
Frederick Perry Shearwood (M. '09), age 91, chief of the technical staff, United Shipyards Ltd., and consulting engineer for the Dominion Bridge Company, Montreal, Canada, died on November 22. In his long connection with the Dominion Bridge Company, Mr. Shearwood was consultant on many important Canadian structures, including the superstructure of the St. Lawrence River Bridge at Coteau and the Interprovincial Bridge at Ottawa. He was also in charge of erection of the Canadian Pacific Railway Bridge at Lachine, the high-arch bridge at St. Johns, and other important bridges for this line. Mr. Shearwood was active in the Engineering Institute of Canada, which he served as president in 1934.

(Continued on page 110)

Tapered beam construction *in warehouse designed and constructed by The Austin Company, Cleveland, Ohio.*

HOW TO DESIGN MORE ROOM

. . . with less steel, less cost



Tapered girder *is fabricated at low cost by welding. Components are simple webs, top and bottom flanges are cut from plate with little or no waste.*

MORE useable space per pound of steel, per dollar cost can be realized through proper use of tapered girder construction made practical by arc welding. Using tapered girders for framing roofs over large areas reduces the number of interior columns or eliminates them entirely depending on the span. Additional economy in construction is realized in reduced overall height of exterior walls. This results from less depth of web at girder ends.

Tapered girders are simply fabricated with two halves of web cut from wide plates, fillet welded to top and bottom flange plates using fast, downhand manual or automatic welding.

ARCHITECTS . . . ENGINEERS! Latest data on structural design is presented completely in new 466 page section on designing welded structures in 11th Edition Procedure Handbook of Arc Welding Design and Practice available at small cost. Write . . .

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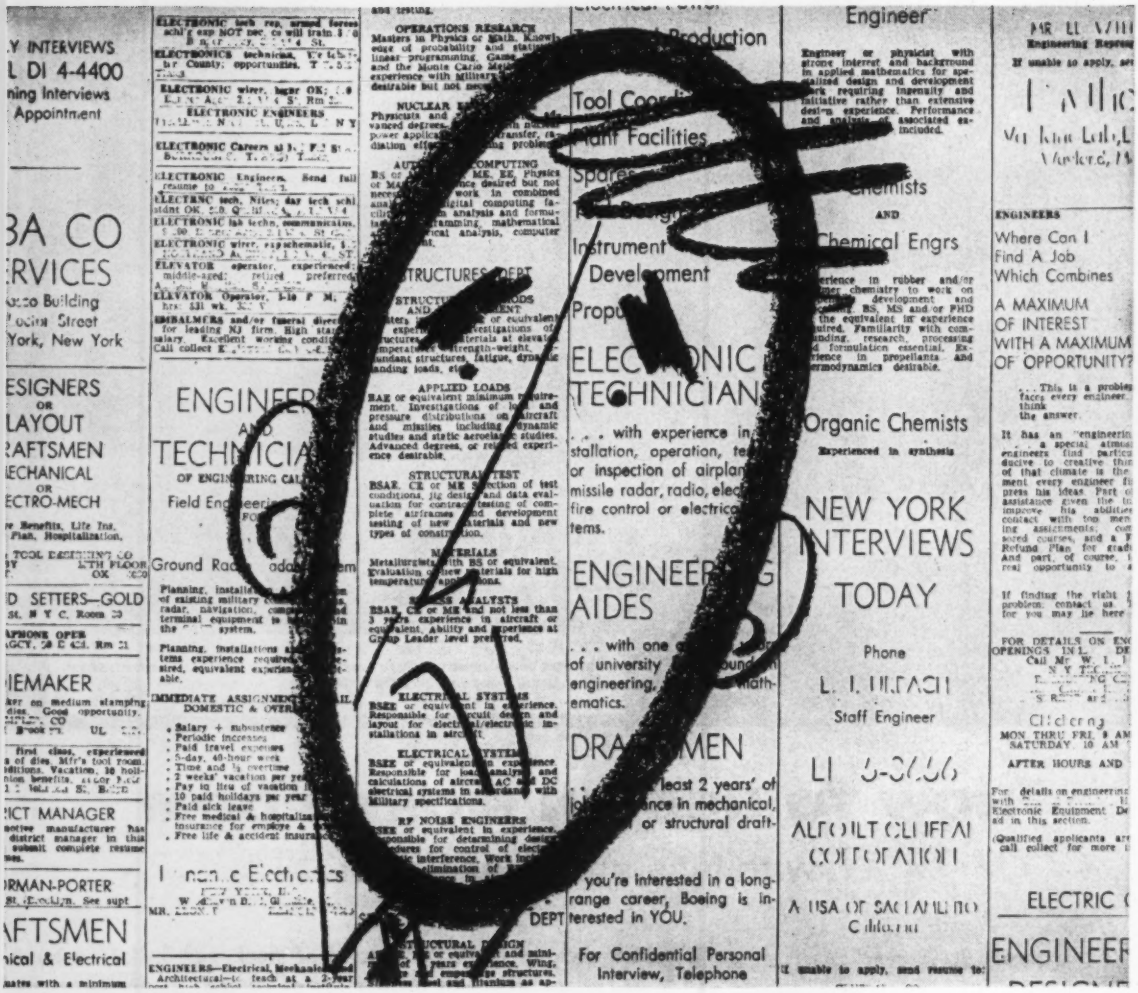
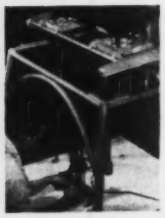


Manpower problems holding up your highway mapping?



Before your highway program can become a reality, there's the manpower-consuming job of mapping route strips. Can't spare scarce engineers for this important step? Let AERO Service do the job from the air!

AERO has the experienced engineers, the aircraft and the modern plotting instruments to handle the entire mapping job—leaving your own busy engineering staff free for other important duties.

AERO topographic maps provide a precise guide for establishing center lines and profiles, fill-borrowing areas and other planning and development work. Let us discuss your highway mapping program now.

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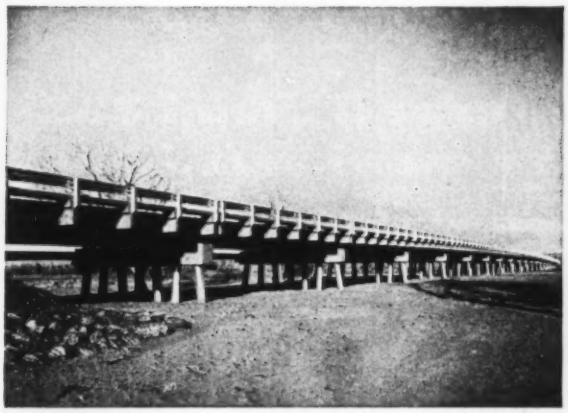
PLANIMETRIC MAPS • PRECISE AERIAL MOSAICS • RELIEF MODELS

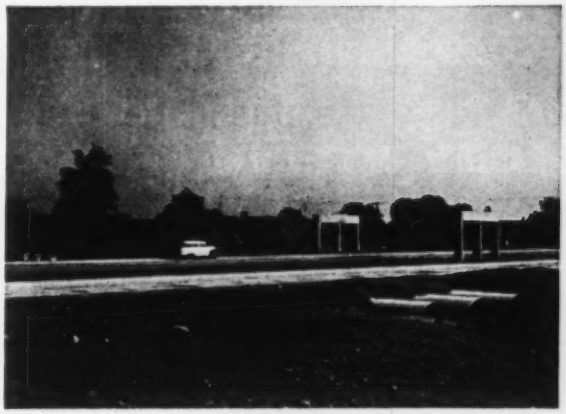
How highway builders are solving stream-crossing problems

New and relocated highways usually involve many stream crossings. Here are some ways that Armco Construction Products have helped engineers solve this problem.

U.S. 10, MONTANA—9-foot-diameter Armco MULTI-PLATE® Pipe carries a stream under this relocation of U.S. Highway 10, west of Butte, Montana. A 70-foot earth fill covers the pipe to provide a maintenance-free "bridge."



RIO GRANDE RIVER BRIDGE—Armco Pipe Pile Bents provide the foundation and supporting piers for this 962-foot bridge across the Rio Grande, north of Albuquerque, New Mexico.



U.S. 25, OHIO—The problem here was low headroom and large waterway requirements. MULTI-PLATE Pipe-Arch, with a low rise-wide bottom, provided the necessary waterway area under the normal level of the road.

Write for data

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The Bonnie Phosphates Chemical Plant • International Minerals & Chemical Corp.
Engineers & Constructors—The Rust Engineering Co.

Compaction of sandy soil by Vibroflotation®

saved $250,000 over the use of pilings, for building foundations in Florida.

The Bonnie Phosphates Chemical Plant of International Minerals & Chemical Corporation was built upon sand that was compacted by Vibroflotation.

In addition to savings estimated by the engineers at $250,000, Vibroflotation provided a rapid, effective solution to the problem of eliminating foundation settlement, even under exceptionally heavy dynamic loads.

Deep test pit cut into compacted area at Bonnie, Florida

Because of the excellent results of the first application in 1950, Vibroflotation was again used in 1954 and in 1956 for expansion of the same plant.

Over 3,000 Vibroflotation penetrations made in 5 acres for original plant. A 30% relative density of sand increased to a minimum of 70%.

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V-11

Rapid sand filters . . .

(This article begins on page 33)

(Continued from page 37)

pacity of 20 mgd. A wash-water tank will be located at each end of the filter building. Under normal conditions two pumps will discharge into the northerly tank and the northerly half of the system, and two into the southerly tank and the southerly half of the system.

Rate of wash-water flow will be set manually at each of two master control panels, and the quantities will be measured and recorded through meters in the pump discharge headers and the outlet pipes from the tanks. A summator and rate setter on each of the two master control panels will control the rate of back wash. The design provides for washing one double filter unit in each gallery at the same time.

A sand and gravel ejecting and washing system, with storage bins, is being provided.

The wash-water pumproom will be at pipe-gallery elevation in the northerly row of filters. The operating floor of the wash-water pumproom will be occupied by switchgear and battery rooms, operators' headquarters, and lunch, locker, and toilet rooms.

A two-story Office Building is being constructed on the State Road at the northerly side of the rapid sand filters. The basement will house boilers and dehumidifying equipment; the first floor will include superintendent's and clerks' offices, lecture and conference rooms, storage room, etc.; and the second floor will provide space for bacteriological and chemical laboratories and for laboratory personnel.

Effluent water from the rapid sand filters will flow by gravity from the weir chamber at the southerly end of the building through two 10-ft conduits into the Post Chemical Building, where facilities are being provided for post treatment of the water. Eight rapid mixing basins with lime feeders and slakers for the application of lime together with lime bins, will be housed in this building. There will also be equipment for application of chlorine, fluorides and phosphates for corrosion control.

Provisions will be made for applying chlorine from this location to the existing 9-ft effluent conduit leading to the clear-water basin and the filtered-water pumping station at a point below the effluent lines from the slow sand filters so that all water from these filters can be booster chlorinated

(Continued on page 108)

245 hours less greasing time...
245 hours more profit time EVERY YEAR!

Time saved by 1,000-hour lubrication intervals on your Allis-Chalmers tractor adds up to 245 hours every year—an extra month of production!

On truck wheels, support rollers and idlers, an exclusive combination of positive, spring-loaded seals and tapered roller bearings keeps out dirt and moisture, prevents loss of lubricant.

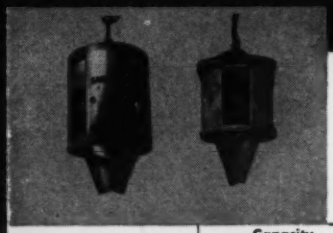
For 1,000 tractor work hours, you can forget about every grease point below track level. When it's time for servicing, simple low-pressure flush lubrication replaces old grease completely, eliminates seal popping, prevents damage to seal faces. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

IT'S SIMPLE ARITHMETIC!

	Other Tractors	Allis-Chalmers Tractors
No. of greasings per year (5,000 hr)	up to 500	5
Greasing time (av. conditions)	½ hr	1 hr
Time spent greasing	up to 250 hr	5 hr
PRODUCTION TIME GAINED . . . 245 HOURS EVERY YEAR!		

ALLIS-CHALMERS *Engineering in Action*

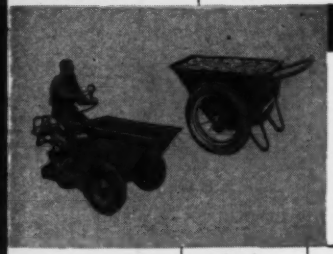
AN EASY GUIDE TO
concrete handling equipment
CAPACITIES



CONCRETE BUCKETS

Choose your buckets from Gar-Bro's 33 different types and sizes ranging from ⅓ to 8 cu. yds. They handle all concrete mixes and aggregate sizes—are available in round or laydown types. Each is equipped with Gar-Bro patented self-closing, grout tight, double clamshell gates. Consult the chart below for sizes and types.

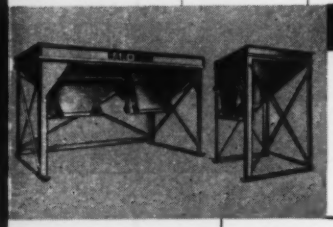
Type	Capacity (cu. yds.)	Concrete Slump	Aggregate Size (Max.)	No. of Bucket Sizes
LIGHTWEIGHT	⅓ to 1½	Normal	3"	5
STANDARD DUTY	¾ to 4	Low Slump	3"	6
HEAVY DUTY	2 to 8	Dry	6"	6
LAYDOWN	½ to 3	Normal or dry	3" or 6"	16



CONCRETE CARTS POWER, HAND

See and compare Gar-Bro Power Carts. They were designed for concrete handling. Nothing can match the power-cart for speed, power, capacity and maneuverability for handling concrete. Concrete hand carts are balanced for easier pushing and dumping, get more loads per day because they are matched to man's muscle. Check the chart below for the type that suits your job.

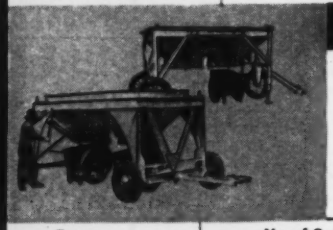
Equipment	Load Capacity	Maximum Travel Distance	Speed	Capacity* per Hour
POWER-CARTS	12 cu. ft.	1000 ft.	15 mpr.	15 to 20 cu. yds.
CONCRETE CARTS	6 to 8 cu. ft.	200 ft.	walking	3 to 5 cu. yds.
			*according to hauling distance	



CONCRETE HOPPERS

Make your selection from 16 models of Gar-Bro Hoppers. They serve as intermediate storage for concrete. Increase your concrete placing speed and prevent truck mixer delays. Use the chart for further details.

Type	No. of Gates	Cap. (cu. ft.)	Attachments
VERTICAL FRONT	Single	28 to 67	Collars & Stands
CENTER DISCHARGE	Single	32 to 72	Collars & Stands
VERTICAL FRONT	Double	54 to 135	Collars & Stands
CENTER DISCHARGE	Double	63 to 144	Collars & Stands



PORTABLE HOPPERS

These wheeled Gar-Bro Portable Hoppers provide a mobile concrete supply station for cart crews. Are built for easy charging by truck mixers and speeds discharging for cart loading. Refer to the chart for the type and size that fits your requirements the best.

Type	No. of Gates	Cap. (cu. yds.)	Type of Gate
PORTABLE	2	2 to 3	Double Clamshell
SEMI-PORTABLE	2	3 to 4	Double Clamshell

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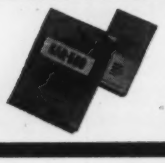

Write for Gar-Bro Catalog No. 300 and Gar-Bro Manual or see your dealer.

Rapid sand filters . . .

(This article begins on page 33)

(Continued from page 106)

to secure the desired residual of the combined effluent water. Lime for pH correction will be applied in the influent conduits and the other post-treatment chemicals in the effluent conduits from the Post Treatment Building, Venturi meters being installed for controls. In addition, chlorine and chlorine dioxide will be applied in the effluent conduits from this building by feeding equipment in the main chemical structure.

A concrete conduit of 10-ft and 8-ft diameter will be provided to connect with the existing piping now supplying treated water to the slow sand filters. A second concrete conduit, of 10-ft diameter, will be constructed from the Post Chemical Building paralleling the existing effluent conduit from the slow sand filters to a point between the slow sand filters and the clear water basin (Pennypack Street) where it will connect with the existing conduit. This conduit will provide a by-pass of the slow sand filters as well as sufficient capacity in outlet conduits for maximum rates of filtration.

Conversion of the existing slow sand filters into a filtered-water reservoir will increase the filtered-water storage at this plant by approximately 150 million gal, providing a total storage capacity of 200 million gal, which is approximately one day's supply at the present average daily rate of use.

Ten contracts for this project have been awarded and are now under construction, totaling about $12,700,000. Fourteen other contracts, now in the design stage, will total about $6,500,000. The above contracts do not include additional raw-water pumping equipment, estimated at $1,940,000, or conversion of the slow sand filters into a filtered-water reservoir, estimated at $700,000.

As with many large projects, construction difficulties slowed down the work. The area occupied by the sedimentation basins and rapid sand filters was originally a dense woodland and required clearing. Substructures, particularly those for the filters, extend about 16 ft below the average ground-water level, and the foundations had to be drained by a well point system surrounding the area. However, the sedimentation-basin contract is now approximately 90 percent complete and the filter substructure contract approximately 70 percent complete.

Strength, Color and Workability of Atlas Mortar are features that pleased Contractor L. A. Swyer of Albany, N. Y., on Dormitory Building job (above) at Rensselaer Polytechnical Inst., Troy, N. Y. Clean, modern design is work of Architect Henry L. Blatner, Albany.

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- Quality-controlled manufacture of Atlas Mortar promotes uniformly good performance and appearance. (Complies with ASTM and Federal Specifications.)

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Western Pacific RR bridge. Bridge engineers of the Western Pacific RR, designers. Ben C. Gerwick, Inc., San Francisco, general contractor.

Close-up of voided slabs showing hollows formed by 16" O.D. SONOVOIDS.

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Deceased

(Continued from page 102)

Herman H. Smith (A.M. '12), age 82, who was chief engineer of the New York Board of Estimate under Mayor James J. Walker, died at a nursing home in New Boston, Mass., on March 3. His home was in Winsted, Conn. Mr. Smith had been construction engineer and division superintendent for the Long Island Railroad, and later (1912 to 1921) was surveyor and chief engineer of the Brooklyn Bureau of Highways. Mr. Smith was an 1899 graduate of the Massachusetts Institute of Technology.

Richard Hampton Vose (M. '08), age 90, retired consulting engineer with Robert W. Hunt & Co., Chicago, Ill., died there recently. Mr. Vose was connected with the Robert W. Hunt Co. from 1912 until his retirement seven years ago. Earlier he built railroads in Mexico, and operated mines in Canada and South America.

RECENT BOOKS

(Added to the Engineering Societies Library)

Advances in Geophysics, Vol. 3

The following subjects are covered in the seven substantial review papers making up the present volume in this series: Arctic ice island research; the polarization of sky light; subcontinental structure in the light of seismological evidence; heat flow through the deep sea floor; the earth's interior; subsurface geophysical methods in groundwater hydrology; and geophysical research with artificial earth satellites. (Edited by H. E. Landsberg. Academic Press Inc., 111 Fifth Avenue, New York 3, N. Y., 1956. 378pp., $8.80.)

Flachentragwerke
Fourth Edition, 1956

A detailed treatment, by Karl Girkmann, of the elastostatics of plate structures, which discusses the important problems involved in the calculations of stresses and deflections in plates, shells, and prismatic structures. For practical use the analytical solution of a wide range of such problems is carried out, with particular attention to the underlying principles. (Springer-Verlag, Vienna, Austria. 596pp., $15.70.)

Frost-und Tauschaden an Verkehrswegen und Deren Bekampfung

A specialized treatment of frost and thaw damage to highways and railways. The book cites the basic factors; discusses the primary and secondary influences of weather, structural conditions, surfaces, loads, etc.; gives a résumé of current knowledge; and devotes a considerable

(Continued on page 112)

Progress in New Orleans

Old Man River is far below as Bethlehem bridgemen place truss steel for the Greater New Orleans Bridge. The high point of the truss, directly over a main pier at right, will be 362 ft above low water. The traveler shown on the job is equipped with a 115-ton-capacity stiffleg derrick with a 115-ft boom, and a 25-ton-capacity derrick with a 90-ft boom. Both derricks are mounted on a 100-ft tower.

The bridge's main span is of cantilever design. At 1,575 ft it will be the longest of its type in the United States, and third longest in the world. It allows 150 ft clearance.

Over-all length of the main bridge is 3,019 ft. The elevated approaches add another 7,700 ft or so. Our contracts, totalling 33,670 tons of fabricated structural steel, also include installing 900 tons of eye bars, 1,400 tons of steel grid flooring, 30 tons of grating and 6,000 lineal ft of handrail, plus paving, the drainage system, lighting and electrical work.

The bridge is a project of the Mississippi River Bridge Authority of the State of Louisiana. *Designer and engineer:* Modjeski & Masters, of Harrisburg, Pa.

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Recent Books

(Continued from page 110)

section to remedial or preventive measures, both for existing roads and for new construction. (By Lothar Schaible. Wilhelm Ernst and Son, Berlin, Germany, 1957. 176pp., DM22.)

Graphics for Engineers

A book on engineering drawing which covers the fundamentals. Emphasis is on engineering geometry, multiview representation, basic descriptive geometry, and freehand sketching, with particular attention to perspective pictorials and graphical methods for solving engineering problems. The purpose is to develop the ability to visualize spatial conditions and to use graphical forms of representation as a means of communication. There is a special chapter on graphs, charts, and nomograms. (By Warren J. Luzadder. Prentice-Hall, Inc., Englewood Cliffs, N. J., 1957. 597pp., $8.65.)

Landslides in Clays

Alexandre Collin, one of the pioneers in soil mechanics, originally published this treatise in French in 1846. In it he develops theories of landslides remarkably similar to those of recent years and presents field data, still of value, on about fifteen slips. He also reports the results of the first shear tests on clay ever conducted, and demonstrates the importance of water content to the strength of clay soils. The volume includes a memoir of the author by A. W. Skempton. (Translated into English by W. R. Schriever. University of Toronto Press, Toronto, Canada, 1956. 160pp., $6.50.)

Lexique Technique Français-Anglais, Anglais-Français (2 vols.)

This standard English-French technical dictionary, currently in its fourth edition, now has a companion French-English volume. It covers the whole field of technology: construction work of all kinds, machines and machine-shop practice, electrical engineering and electronics shipbuilding, mining, metallurgy, petroleum, transportation, etc. Different meanings are given for various contexts, and numerous examples of phrases and combinations are given for many words. (By Guy Malgorn. Gauthier Villars, Paris, France, 1956. $7.06 per volume.)

The Plastic Methods of Structural Analysis

The first part of this book, intended for practicing structural engineers and research workers, is concerned with a presentation of the plastic methods of analysis that have been developed for calculating plastic collapse loads for frames with the ultimate objective of establishing rational and economical design procedure. The last part deals with closely associated topics, such as estimates of deflections; factors affecting the fully plastic moment; minimum weight design; and variable repeated loading. There are examples to illustrate each chapter. (By B. G. Neal. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 1956. 353pp., $7.50.)

Principles of Engineering Geology and Geotechnics

A reference work for practicing civil engineers and engineering geologists, and a text for advanced students in these fields. The first eight chapters contain general geotechnical information. The remaining eleven chapters deal with applications in the design and construction of bridges, dams, tunnels, runways, buildings, shore structures, etc., and also with special problems such as permafrost, sedimentation, landslides, and aseismic design. (By D. P. Krynine and W. R. Judd. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1957. 730pp., $10.00.)

Surveying, Elementary and Advanced

Two volumes are incorporated in this text: the third edition of the authors' *Elementary Surveying* and a revision of the second edition

(Continued on page 114)

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(Continued from page 112)

of Professor Rayner's *Advanced Surveying*. Major emphasis is placed on elementary surveying fundamentals rather than on techniques that can be learned outside the classroom. In the advanced surveying section, a comprehensive mapping or charting project is detailed to show the interrelationships between the field and office operations. Sections on photogrammetry, topographic mapping, hydrographic surveying, mine surveying, and altimeter surveys are included, as well as a short history of surveying. (By William H. Rayner and Milton O. Schmidt. D. Van Nostrand Company, Inc., Princeton, N. J., 1957. 916pp., $8.50.)

Symposium on Specific Gravity of Bituminous Coated Aggregates

Special Technical Publication No. 191

This symposium consists of six papers dealing with the role of specific gravity in the design and control of bituminous paving mixtures, the measurement of specific gravities of bituminous mixtures and aggregates, and the specific gravity and voids relationship in bituminous pavement mix design. (American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa. 71pp., $2.00.)

Traite de Mecanique des Sols

A comprehensive treatment of soil mechanics, beginning with a general section on the physical properties of soils, especially permeability. The second section deals with specific mechanical properties of soils: stresses and deformations; settlement; vibration phenomena; equilibrium; and shearing action in both cohesive and cohesionless soils. The third section covers engineering applications: methods for improving soil properties; pressures on retaining walls; pressure distribution under foundations and bearing capacities; and special topics such as piling, tunnels, roadway loading, and earth slopes. (By A. Caquot and J. Kerisel. Gauthiers-Villars, Paris, France, 1956. 558pp., $11.15 postpaid.)

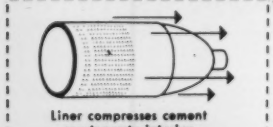
Water for Industry

AAAS Publication No. 45

Nine papers presented at a symposium, held at the Boston meeting of the AAAS in 1953, to focus attention on the importance of the water problem to both national security and internal economic stability. The papers deal with water supply and water requirements; the geographic distribution of industry; waste treatment and disposal in the atomic energy industry, and water pollution abatement. Two treat specific cases: water supply at the Fairless Works and the restoration of the Schuylkill River. (Edited by J. B. Graham and M. F. Burrill. American Association for the Advancement of Science, 1515 Massachusetts Avenue, N.W. Washington 5, D. C. 131pp., $3.75.)

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and translations services, and can supply photoprint or microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N.Y.



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Now simplicity, efficiency and manpower savings come to filter plants with the new Simplex Automated Filter Operating Table.

From one central point, filtering and washing cycles can be initiated automatically . . . all rates and times maintained accurately. Valve action is completely pneumatic! The system contains no electrical devices that might malfunction in the dampness of a wet pipe gallery.

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This new system automatically shuts off a filter if the clearwell is filled—returns it to service when needed. Depending on the control you prefer, a filter will be automatically removed from service for backwashing when (1) loss of head reaches cut-off point you pre-set (usually 8') or (2) electric timer has run through the value you pre-set (80 to 120 hrs.). At any point, the operator can manually over-ride these automatic controls.

No-Flood Washing

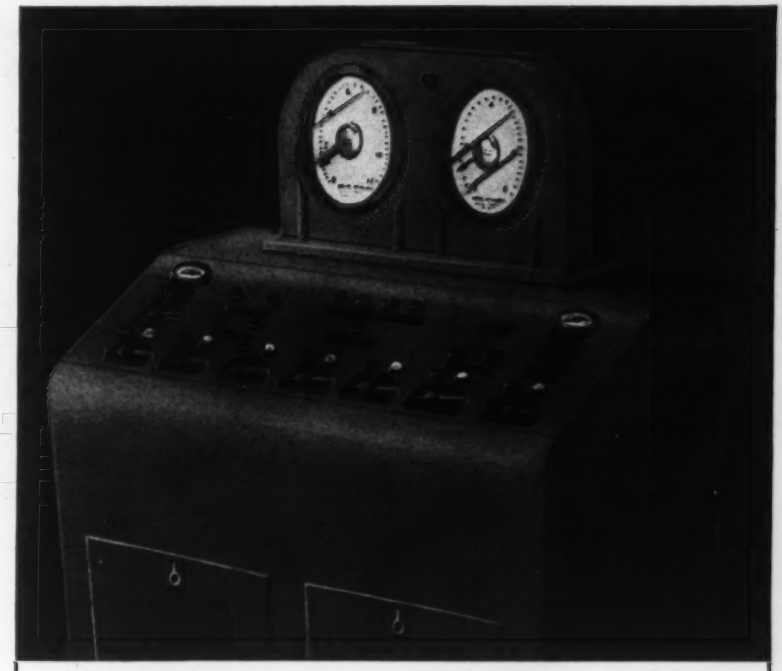
When automatic program starts, the filter Influent Valve is closed, water level drops to wash-trough lips, then the filter Effluent Valve is closed.

Next the Drain Valve is opened, followed by the Wash-Water Valve. Pneumatic interlocks prevent flooding: wash valve can't open until drain valve is fully open.

Washing is precisely timed at slow-fast-slow rates . . . so bed is cleaned and hydraulically graded for clean starts and optimum results.

Saves Treated Water

To prevent flooding, Drain Valve can't close until all Wash Valves have first closed. To prevent waste of treated water, filter Influent Valve can't open until drain valve has completely closed. Washing period can be extended, if desired.



NEW SIMPLEX AUTOMATED FILTER TABLE: Large dials indicate and/or record rate of flow and loss of head. Smaller dials set filtration and wash rates. Colored lights show progress of the automatic cycle. Manual levers permit operator to over-ride the automatic programming at any point.

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Cascade programming makes mistakes impossible. All valves open and close in their proper sequence.

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Obviously the control functions built into this new Simplex Table can also be used to control a series of filters. We'll gladly discuss your plans for integrated sequential control that interlinks all filters for fully automatic operation of an entire filter plant.

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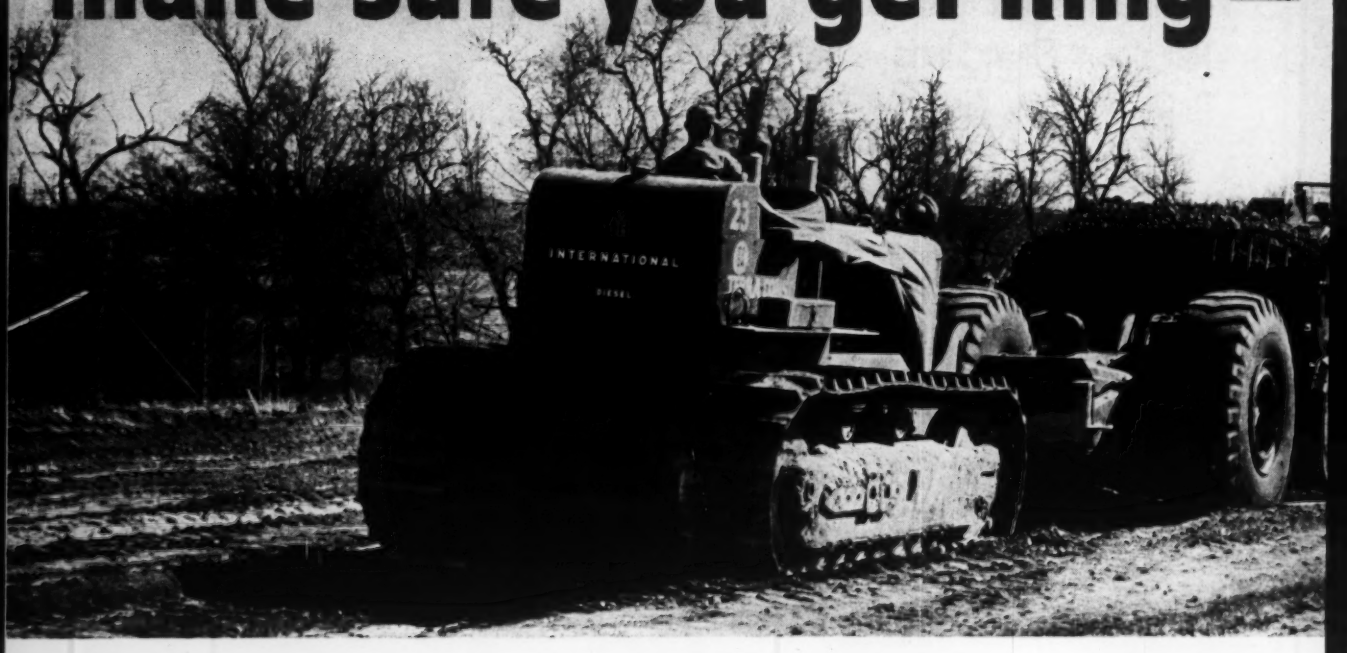


Make sure you don't wear blinders when you invest in king-sized crawler power!
Make sure every dollar you invest buys the top pay-off power features. Look to the International TD-24 for the most profitable king-sized crawler performance your money can buy!

Make sure you don't dissipate dollars on a king-sized machine with load-limiting, "dead-track drag"!
The useful load of any king-sized, steering-clutch crawler is limited to what it can pull or push on turns. "Dead-track drag" hogs horsepower!

Exclusive and years-proved Planet Power steering gives the TD-24 full-time live power on both tracks. Upgrade or down, the TD-24 pulls or pushes its big loads on the turns or straight ahead, *with both tracks!*

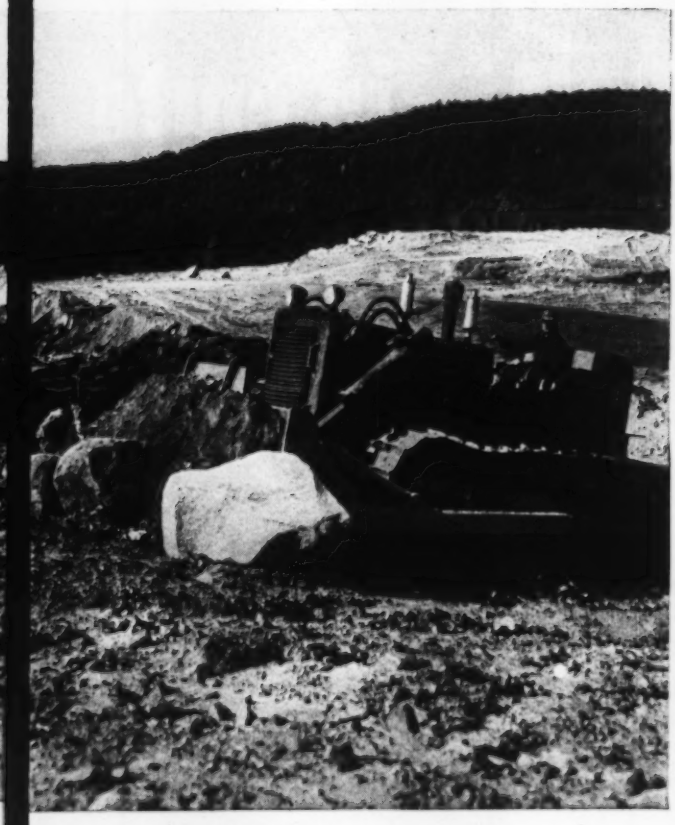
Make sure you don't drop big money in high-priced time losses with "service-nervous" engine clutch complications!
The TD-24 gives you the operating ease, power-transfer efficiency, temperature-immunity, and service economy and simplicity of the International Cerametallic-faced engine clutch. And heat-defiant, long-lasting Cerametallic facings have amazing resistance to wear!

In your king-sized tractor, make sure you get your big money's worth—by getting the cycle-speeding advantages of TD-24 on-the-go shifting!
And compare how the TD-24's exclusive two-speed planetary system gives instant, stall-preventing Hi-Lo shifting without declutching in either the Torque-Converter or Gear-Drive models. You also get the added advantage of "no-stop" shifting with exclusive synchromesh transmission in the Gear-Drive model.

Make sure you don't fizzle away big finances by handicapping your operator—give him a break!
Give him TD-24 flush-deck design, control-tower vision, and reach-easy finger-tip controls to increase operator comfort and performance. Give him "one-engine" simplicity for seconds-fast starting and dependable diesel operation. Give him ALL of the dozens of other king-sized production-boosting TD-24 advantages!

Make sure you invest wisely and get full dollar value in giant-sized performance. See your International Construction Equipment Distributor for a TD-24 demonstration!

a king-sized crawler -sized performance!



With the TD-24 Torque Converter model as pusher, four International 75 Payscraper units prove able to outperform a fleet of six competitive self-propelled scrapers! Contractor, Terra Construction Co., Great Bend, Kansas, is handling a 500,000 cu yd grading job on Kansas 15, near the Nebraska line. "Perfect performance from all our International equipment," states Job Superintendent Weller.

"Where our other tractors failed this TD-24 has the stuff to get the job done," reports Mike Cashen, for Cashen and Erickson, Hibbing, Minnesota. "It is fast, easy to maneuver, and the only tractor we found that could load in these rocks." The job is building a tailings settling pond at a new Taconite plant in the Mesabi Iron Range. Because it's tough, the TD-24 wins the job of push-loading three self-propelled scrapers, and 'dozing boulders aside!

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"65" PAYHAULER® hauls

4-ton rocks and ⅔-mile haul involved in Oregon road straightening job!

The wet, sticky clay in these pictures will give you an idea of the working conditions encountered by the "65" Payhauler operated by the Funderburk Construction Co., Sutherlin, Ore., on their 2-mile road job near Elkton. This clay cut machine efficiency on the job as much as an estimated 50%. Truck bodies had to be scraped clean periodically. And a bogged-down 1½-yd shovel had to be replaced by a sure-treading 3-yd International Drott TD-18 Skid-Shovel®.

In spite of these rough working conditions...and in spite of big 4-ton blocks of rock found in the clay...the International "65" Payhauler still maintained an average of 96 yds per hour on the ⅔-mile haul to the fill.

Veteran earthmover and Payhauler operator, Aaron Johnson, stated, "Here is the poorest loading material I've ever seen. Still I'm getting six 16-yard loads each hour over a cycle distance of 1⅓ miles."

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Rock, bigger than 3-yd Skid-Shovel bucket, found in wet clay cut operating efficiency. Payhauler body, fabricated from abrasion-resistant high-tensile steel, together with strongest frame in its class, stands up to tough punishment of rock loading.

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96 yds per hour

of job-bogging sticky clay!

Double-acting hoist cylinder in all stages with 106,300 pounds of force in first stage raises body in seconds. Hydraulic snubbing action prevents undue stress on hoist cylinders and "gentles" body return to frame.

International Drott TD-18 Skid-Shovel replaced 1½-yd shovel to load clay, big boulders into "65" Payhauler. "65" gives you big, bonus-producing 18-ton capacity, Model "95," 24 tons.

International trio...TD-18 Skid-Shovel, TD-24 tractor and Model "65" Payhauler promote production for Funderburk Construction Co., in spite of wet, sticky clay and big, stubborn rock.

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Men Available

CONSTRUCTION ENGINEER, J.M. ASCE; B. of C.E.; 25; three years' field work, one year office design work, one year selling building materials and supervising their installation. Good administrative ability for contract and general liaison work. Location desired, New York area. C-212.

CONCRETE ENGINEER, M. ASCE, registered P.E.; 25 years' in concrete and other construction materials; in charge of laboratory testing and field construction, and as a development engineer in concrete and concreting materials. Desires affiliation with a concern offering a wider scope of activity than research testing of materials of construction. C-213.

CIVIL ENGINEER, J.M. ASCE, BSCE 54; M.S.E. 55, Yale University; 25; married. Some experience working with Latin American laborers. Speaks Spanish fluently, has understanding of French. Desires teaching position. Citizen of Central America. C-214.

PARTY CHIEF, CONSTRUCTION SUPERINTENDENT, INSPECTOR, A.M. ASCE; 55; thirty years' of experience in civil and military engineering divided as follows: Fourteen years' civil engineering experience progressively from sub-professional to professional in responsible charge category as, rodman, chainman, instrument man, draftsman, party chief, field engineer, construction inspector, assistant district engineer, and chief draftsman. Location desired, United States. C-215.

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ESTIMATOR to follow through the shop and check in the field. Prefer practical type who has had supervisory experience. Fabrication background desirable. Salary open. Location, Newark, N. J., area. W-4029. Rewritten.

INSTRUCTORS OR ASSISTANT PROFESSORS for civil engineering department; master's degree and teaching experience desirable but not required. Will teach courses in one or two of the following areas: Surveying, Structures, Hydraulics or Transportation. Nine-month year; salaries open, dependent upon education and experience. Positions available September 1957. Location, New York metropolitan area. W-4518.

VALUATION ENGINEER, graduate civil or mechanical, 28-45, with some practical experience in pricing or estimating current costs of utility property; either with utilities, appraisal or engineering companies, or regulatory commissions. Some construction work and cost accounting knowledge desirable. Will participate in the development of unit costs, such as material, labor and overheads, applicable to the inventory quantities of natural gas utility properties. Salary, to $8,400 a year. Some travel. Location, Ohio. W-4565.

SALES ENGINEER, 24-30, civil graduate, with concrete experience, for technical field work with customers of cement manufacturer. Salary, $4,800-$6,000 a year, plus expenses and company car. Location, Northeast. W-4600.

CIVIL ENGINEER, Structural, 25-45, degree in civil engineering, and preferably licensed. Experience in structural design of bridges, building and foundations, including stress analysis, required. Will design and develop various structural applications of aluminum to satisfy customer requirements or improve product. Salary open. Location, West Coast. W-4750.

PUBLIC WORKS DEPARTMENT ENGINEER AND SUPERINTENDENT for western Massachusetts community. Apply by letter submitting résumé of education and experience. Salary open, based on experience. W-4758.

STANDARDS ENGINEER, B.S. in M.E., Ch.E. or C.E., with 3 to 4 years in standards department of a chemical company or a refinery out of six to eight years' total experience in chemical or refinery industry in responsible positions in design operations or 8 to 10 years' experience in chemical or refinery industry in responsible design position. Will be required to assemble existing company design practices and combine with generally accepted modern design practices in similar industry into standards and specifications. Standards and specifications are in the categories of: (1) Structural steel and buildings; (2) Concrete and foundations; (3) Piping design, materials and fabrication; (4) Electrical; and (5) Process equipment. Salary, to $10,000 a year. Location, Pennsylvania. W-4769(c).

ASSISTANT PORT ENGINEER, graduate civil engineer or equivalent, with 4 years' experience in design and construction of port or municipal facilities. Salary, $6,000-$7,200 a year, plus benefits. Apply by letter sending experience record and references. Location, Florida. W-4772.

ARCHITECTURAL ENGINEER AND DESIGNER, young, with 2 to 3 years' experience for consulting firm. Civil engineer with architectural background acceptable. Salary, $6,000 a year, plus. Location, Massachusetts. W-4781.

CIVIL ENGINEERS FOR A MUNICIPALITY: (a) Grade I, 21-35, B.S. in C.E., salary, $4,992-$5,980 a year; (b) Grade II, 25-55, B.S. in C.E., with at least 2 years' experience, salary, $5,720-$6,864 a year. Location, Virginia. W-4801.

CIVIL ENGINEER, experienced, for medium-sized contracting firm engaged in heavy construction, principally highways, airports, bridges. Duties will include engineering layout for excavation, paving and structures; estimating proposed jobs; and computing quantities of work done. Work will touch on all operations of company and lead to executive position for right man. Salary

(Continued on page 124)

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Men and Jobs Available

(Continued from page 122)

open. Reply by letter giving résumé of education, experience, and references. Location, East. W-4821.

CHIEF CONSTRUCTION INSPECTOR AND INSPECTORS in civil, electrical, mechanical, structural and utilities for private construction company on large government project in Philippines. Duration 18 months to 2 years. Salary, $10,000 a year and up. F-4827.

STRUCTURAL ENGINEER familiar with building design as well as bridge design. Salary open. Location, Pittsburgh, Pa. W-4842.

STRUCTURAL ENGINEER. Must have professional engineer's license in the State of New York; some experience in structural design, building construction and maintenance of buildings and grounds. Will not handle any mechanical items. Salary, to start $9,360 a year, with opportunity to advance to $10,322 a year. Location, upstate New York. W-4846.

CIVIL ENGINEERS, graduates, with experience in testing and control of concrete, asphalt, and soils for work abroad. Salary, $8,000-$10,000 a year. Apply by letter giving full details of experience and education. F-4847.

ASSOCIATE PROFESSOR for transportation and soils engineering in civil engineering department of large eastern metropolitan university. Starting salary, about $7,500 for nine months depending upon qualifications. W-4849.

SANITARY ENGINEER. Civil Engineer or Sanitary, to 40; with 2 or more years in the field on construction or design in hydraulics or sanitary field to assist in preparing field inspection reports and studies on sanitary, municipal, and hydraulic projects; must be good public speaker with ability to meet people; good opportunity for a trade association. Salary, up to $8,400 a year. Employer will pay placement fee. Location, Chicago. C-5939.

Non-ASCE Meetings

American Institute of Chemical Engineers. National Meeting of A.I.Ch.E. at the Olympic Hotel, Seattle, Wash., June 9-12. Information from Marshall T. Ramstad, Pennsalt Chemicals Corporation, Western Division, 2901 Taylor Way, Tacoma, Wash.

American Institute of Steel Construction. Ninth Annual National Engineering Conference at the Edgewater Beach Hotel, Chicago, Ill., May 27-28. Information from AISC, 101 Park Avenue, New York 17, N. Y.

American Planning and Civic Association. 1957 National City Planning Conference at the Marion Hotel, Little Rock, Ark., June 9-12. Information from Metroplan, 209½ West Second Street, Little Rock, Ark.

American Society for Engineering Education. Sixty-fifth annual meeting at Cornell University, Ithaca, N. Y., June 17-21. Information from W. Leighton Collins, Secretary, ASEE, University of Illinois, Urbana, Ill.

American Society for Testing Materials. Annual meeting of ASTM at Chalfonte-Haddon Hall, Atlantic City, N. J., June 16-21. For information write ASTM, 1916 Race Street, Philadelphia 3, Pa.

American Society of Mechanical Engineers. Second Design Engineering Show at the New York Coliseum, May 20-23. Information from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

American Water Works Association. AWWA Annual Conference in Atlantic City, N. J., May 12-17. Information from AWWA, 2 Park Avenue, New York City, N. Y.

National Society of Professional Engineers. Annual meeting at Dallas, Tex., June 5-8. Information from the NSPE, 2029 K Street, Washington 6, D.C.

Purdue University. Purdue Industrial Waste Conference at the Purdue Memorial Union Building, May 13-15. Information from Don E. Bloodgood, Professor of Sanitary Engineering. Purdue University, LaFayette, Ind.

University of Florida. Highway Engineering Conference at the University of Florida, Gainesville, Fla., May 16 and 17. Further information from Professor Emil R. Hargett, University of Florida, Gainesville, Fla.

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New Publications

Kansas Turnpike . . . Covering activities of the Kansas Turnpike Authority during 1956, the Fourth Annual Report emphasizes final construction phases of the ambitious project. The 236-mile, four-lane toll road, authorized in April 1953 and opened in October 1956, cuts across the state at an angle, connecting the Kansas-Missouri border at Kansas City and the Kansas-Oklahoma border south of Wichita. Howard, Needles, Tammen & Bergendoff were the consultants on the project, and Coverdale & Colpitts the traffic engineers. Inquiries about the report should be sent to the Kansas Turnpike Authority, Box 3002 Southeast Station, Wichita 18, Kans.

Earthquake-resistant construction . . . Especially timely in the light of the current San Francisco earthquakes are the Proceedings of the World Conference on Earthquake Engineering—a technical meeting held in Berkeley last year to mark the fiftieth anniversary of the destructive 1906 San Francisco earthquake. The conference—sponsored by the Earthquake Engineering Research Institute and the University of California Department of Engineering—pooled the knowledge of scientists and engineers from major seismic areas the world over. It was concerned with earthquake ground motions; analysis of structural response; development of aseismic construction; earthquake effects on soils and foundations; and design of earthquake-resistant structures. Lithographed copies of the Proceedings are available from Karl V. Steinbrugge, Secretary, Earthquake Engineering Research Institute, Room 1039, 465 California Street, San Francisco 4, Calif. They are $8.50 postpaid.

Review for surveyors . . . Up-to-date reference material for men taking Civil Service, engineer-in-training, and professional registration examinations in civil engineering and surveying is provided in the new (fifth) edition of Prof. R. C. Brinker's classic review questions for surveyors. The present 204-page compilation contains 2525 questions of all types—multiple-choice, completion, discussion, true-and-false—and problems plus typical complete registration examinations. Copies are $3.50 each, or $3.00 apiece in lots of five or more. Orders should be sent to Prof. R. C. Brinker, Box 153, Blacksburg, Va.

Industrial waste . . . Availability of the Proceedings of the Fifth Southern Municipal and Industrial Waste Conference (1956) is announced by the University of North Carolina Department of Sanitary Engineering. The 261-page volume comprises 28 papers, including a keynote article by Prof. Gordon M. Fair on "Water Resources and Waste Disposal Requirements." It sells for $1.50 and may be obtained from the Extension Division, University of North Carolina, Box 1050, Chapel Hill, N. C.

Iron and steel beams . . . Availability of a second printing of its helpful reference, "Iron and Steel Beams," is announced by the American Institute of Steel Construction. First issued in 1953 in response to requests for information on the properties of beams and column shapes, the 142-page volume covers the period, 1873 to 1952. Data on shapes are grouped into five sections on steel and one section on wrought iron. Tabular data are limited to steel and wrought-iron beams and columns. Also included are ASTM specification requirements for tensile strength and yield point, and the working stress recommendations of the AISC. The price is $3.50 a copy prepaid in the United States and Canada (plus the city sales tax for residents of New York). Orders should be sent to the AISC, 101 Park Avenue, New York 17, N. Y.

Standards . . . "Standards—Guides for Tomorrow" is the title of the proceedings of the fifth annual meeting of the Standards Engineers Society, which is now available at $3.75 a copy. Topics covered in the 24 papers comprising the proceedings include standardization of building

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Highway research . . . A wide range of current road research is reported in five recent publications of the Highway Research Board. Bulletin 135 ($3.40), entitled "Factors Influencing Ground Freezing," contains annual meeting papers sponsored by the Committee on Frost Heave and Frost Action in Soils; Bulletin 136 ($1.00) presents annual meeting reports on "Flexible Pavement Design in Four States"; Bulletin 137 (60 cents) consists of two reports on investigation of the effects of different types and widths of median dividers on traffic behavior and accidents; Bulletin 138 (60 cents) is concerned with "Joint and Crack Sealing"; and Bulletin 139 ($1.60) describes some factors involved in "Road Roughness and Slipperiness" and test methods in use. Request for copies should be sent to the Highway Research Board, 2101 Constitution Avenue, Washington, D. C.

Flood studies . . . Availability of a limited number of reprints in booklet form of a paper, entitled "Hydrologic Studies of Floods in the United States," is announced by the author, V T. Chow, A.M. ASCE, research associate professor of hydraulic engineering at the University of Illinois. The paper—presented by Professor Chow at the Congress of the International Association of Scientific Hydrology in France in September 1956—gives an overall picture of the development of hydrologic studies. Recent developments in both analytical and instrumental approaches are also emphasized. Over 150 bibliographical references to flood hydrology in American literature are included. Copies, priced at $1.00 each, may be obtained from Professor Chow, 207 Civil Engineering Hall, University of Illinois, Urbana, Ill.

Shopping center development . . . Emerging patterns of shopping center development have been compiled by the Urban Land Institute and issued as the first of a projected two-part Technical Bulletin identified as No. 30. J. Ross McKeever, director of the Institute, is author of the 80-page study. Part I is currently available, at $5.00 a copy, from the Urban Land Institute, 1200 Eighteenth Street, N.W., Washington 6, D. C.

Waterways Experiment Station . . . Two technical memoranda detailing recent Corps of Engineers investigations, conducted at the Waterways Experiment Station at Vicksburg, Miss., may now be purchased from the Station. They are Technical Report No. 6-437, which is devoted to "Pressure Grouting Fine Fissures," and Technical Report No. 2-447 entitled "Old River Low Sill Control Structure, Downpull Forces on Vertical Lift Gates." They are priced at 75 cents and $1.00, respectively.

Applications for Admission to ASCE—March 2-30, 1957

Applying for Member

ALBERT ALPER, St. Louis, Mo.
GEORGE THOMAS ANDREWS, Little Rock, Ark.
KENNETH OSCAR BAYARD, Detroit, Mich.
JOHN JACKSON BENNETT, Miami, Fla.
HERMAN VON BIBERSTEIN, Charlotte, N. C.
JACK LAWRENCE BOYD, Richland, Wash.
EDWARD ALFRED BRINKMAN, Victoria, Tex.
ROBERT CRAIG BROWN, Massena, N. Y.
EDWARD BOULDIN BURWELL, JR., Washington, D. C.
RICHARD FREDERIC DEANE, Roanoke, Va.
PARSEH SIRUN DIYAROGLU, Ankara, Turkey.
LORENZO CRUZ FRUTO, Honolulu, Hawaii.
EDWARD ARTHUR FULTON, St. Louis, Mo.
HENRY GUSTAVUS FURPHY, Melbourne, Vic., Australia.
GEORGE MARSHALL GANS, Pensacola, Fla.
LEOPOLDO GARRIDO MIRALLES, Merida, Venezuela.
EDWIN LOUIS GIDLEY, Short Hills, N. J.
EDWARD EARL GILLENWATER, Victoria, Tex.

(Continued on page 128)

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Applications for Admission

(Continued from page 126)

KELLY BEAVER HEFFNER, Falls Church, Va.
ADNAH BAIRD HEFFRON, San Francisco, Calif.
IVAN HURST IMPSON, Dallas, Tex.
HERMAN EUGENE KIEFER, Montclair, N. J.
STANLEY KIMBALL, Berkeley, Calif.
FRANK JOSEPH MAGUIRE, New York, N. Y.
FRED RAY MCCORMICK, Boise, Idaho.
JOHN MOSSER MERZWEILER, Cincinnati, Ohio.
WALTER FREDERICK MIDDLETON, South Bend, Ind.
HOMER HORACE MULLINS, West Monroe, La.
JITSUO NIWAO, Hilo, Hawaii.
ROBERT JOSEPH PAFFORD, JR., Omaha, Nebr.
ALBRO LEFILS PARSONS, JR., Washington, D. C.
ERLING FRIDJOF PEDERSON, Massena, N. Y.
EDGAR STEVENS PHILLEO, Fairbanks, Alaska.
MATHEW VALOIS POTHIER, Ada, Ohio.
DONALD OLIVER SCOTT, JR., Petaluma, Calif.
CHARLES NORMAN SIMPSON, Niagara Falls, Ontario, Canada.
ALVA LEE SMITH, Norfolk, Va.
MORTON SOLOMON, Fairfax, Va.
VIRDEN EDWARD STAFF, Chicago, Ill.
EUGENE TOLBERT THOMAS, Jackson, Miss.
JOHN A. TRANTINA, Oakland, Calif.
CLIFFORD CLAY WALKER, Brighton, Colo.
ORVILLE PERRY WHEAT, Lexington, Ky.
WILLIAM HOWARD WILLIAMS, St. Louis, Ill.
BENJAMIN RICHARD WIMER, New York, N. Y.
ALEXANDER JAMES YEATS, Castleton-on-Hudson, N. Y.
WORTH NICHOLAS YODER, Sturgis, Mich.

Applying for Associate Member

BASHIR AHMED, Nairobi, Kenya.
LEOPOLDO BENITES, Guayaquil, Ecuador.
THEODORE GEORGE BIEHL, Birmingham, Mich.
ROBERT DAWSON BOYLE, China Lake, Calif.
FRANK PAUL CARROLL, Los Angeles, Calif.
EMANUEL MORTIMER CHAPETA, New York, N. Y.
DIRK CHARLES CHILCOTE, Black Eagle, Mont.
PANAGHIOTI CONSTANTIN COTZIAS, Baghdad, Iraq.
ROBERT STEINER CRAIG, San Francisco, Calif.
MUTTUWA SARUKALIGE MAITRIPALA DESILVA, Ampari, Ceylon.
ROBERT SPEAS DIEMER, Newport Beach, Calif.
JOHN JOSEPH DOLAN, JR., East Providence, R. I.
LAWRENCE JOHN ELLING, Corpus Christi, Tex.
FRANCIS JOSEPH ENGEL, Casper, Wyo.
JUANITO NERY FERRER, Baguio City, Philippine Islands.
ROBERT JACOB FLICK, Torrance, Calif.
RICHARD SPEIGHT FOUNTAIN, Avondale Estates, Ga.
SATYA PRAKASH GARG, Roorkee, India.
RICHARD LEE GERHART, Reading, Pa.
JOHN FRANK GOULD, SR., Little Rock, Ark.
ELON SAMUEL GUNNING, Los Angeles, Calif.
BRISBANE WALKER HENDERSON, Marysville, Calif.
WILLIAM HERSHLEDER, Massena, N. Y.
ROBERT MILTON HILDEBRAND, Pittsburgh, Pa.
CHESTER KENNETH HUGHES, JR., Duluth, Minn.
GEORGE ARTHUR ZIOZIAS JOHNSON, JR., Charleston, S. C.
GORDON LEONARD JONES, Broad Run, Va.
HOU KE-HUA, Singapore, China.
LINWARD OLIVER KENDALL, Marysville, Calif.
JAMES RICHARD KENNEDY, Clearwater, Fla.
OSMAN ATTILA KURTMAN, Nazilli, Turkey.
CHEN-HWA KWAN, New York, N. Y.
JOHN PAUL LAUBACH, Benton, Pa.
ALBERT MURRAY LOUNT, Toronto, Ont., Canada.
SHERMAN CLAIRE LYON, McCook, Nebr.
VICENT CARLYSLE MCGERVEY, Garfield Heights, Ohio.
DARRELL ROBERT MCLACHLAN, Portland, Ore.
EDWARD MONTELEONE, New York, N. Y.
GRANT ELKANAH MUDGE, Detroit, Mich.
ROY RIUJI NAKANO, Honolulu, Hawaii.
JAMES JOHN NEATE, Cleveland, Ohio.
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ROGER FRANCOIS ROBERT PETIT, Seine, France.
PETER J. RADANO, New York, N. Y.
MARK JOHN SWINBURNE RATHBONE, Natal, South Africa.
AMARDO JOSEPH ROMANO, Boston, Mass.
JOSE IGNACIO RUIZ-MATERA, Denver, Colo.
SANTOSH KUMAR SARKER, London, England.
JOHN ATHANASE SBARBOUNIS, Chicago, Ill.
DAVID DULING SCHMIDT, Denver, Colo.
WALTER SCHOEL, JR., Birmingham, Ala.
CHARLES RICHARD SHETTERLY, Atlanta, Ga.
AVSHALOM SAUL SMITH, Colonia, N. J.
SAMUEL DEWITT SMITS, JR., Cleveland, Tenn.
JOHN WESLEY THOMAS, Americus, Ga.
JOHN STEVE TSAGURIS, Tucson, Ariz.
THOMAS WILKES TUCKER, Albany, Ga.
JACOB CORNELIS VAN DER WIEL, Chicago, Ill.
LEONARD W. WINSTON, Mountain View, Calif.
HAROLD WILLIAM WOLF, Savannah, Ga.
HONG YUEN WONG, Hongkong, China.
APOSTOLOS YOTIS, Athens, Greece.
RICHARD ZAPIOLA ZIMMERMANN, JR., Philadelphia, Pa.

Applying for Affiliate

LAWRENCE HOWARD PETERSEN, Kansas City, Mo.

Applying for Junior Member

JULIAN MILTON ALEXANDER, West Lafayette, Ind.
JAY BURTON AMES, Jackson Heights, N. Y.
OLIVIER YVES BARDE, Montreal, Que., Canada.
ROBERT CHARLES CHIOINO, San Mateo, Calif.
BYRON WILBUR COKE, Los Angeles, Calif.
DOMINIC JOSEPH CUCINOTTI, Fort Dix, N. J.
FRANK JULIAN DAVILA, Caracas, Venezuela.
FRANCIS XAVIER DURKIN, Valley Stream, N. Y.
GORO ENDO, Los Angeles, Calif.
WILLIAM STEPHAN FEDUNEC, Alberta, Canada.
MANSOUR KARIM, Pierre, S. Dak.
WILLIAM NAYLOR KEMP, Concord, Calif.
CLYDE MARION KENNEDY, III, Atlanta, Ga.
FRISBIE KENNETH KILLMAN, San Diego, Calif.
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JOHN HENRY PECK, Ames, Iowa.
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JEAN LOUIS ROMAIN, Fort-Au-Prince, Haiti.
WILLIAM JOHN STEIN, New York, N. Y.
HAROLD HIROSHI TANAKA, Honolulu, T. H.
HARRY FRANK TIERSTEN, New York, N. Y.
LUIS RAFAEL VELASCO, Caracas, Venezuela.
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[Applications for Junior Membership from ASCE Student Chapters are not listed.]

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MANUAL 10 REVISED

CITY SURVEYING PROCEDURE STANDARDIZED

In any community, large or small, boundaries of the original land subdivisions form the basis of all subsequent property subdivisions. Thus, the need for a complete and somewhat standard "city survey" is essential to the successful operation or expansion of any community. Recognizing this very important need, Manual 10 was originally written, and has now been revised, for the purpose of describing the various divisions of a city survey, to furnish specifications for it, and to make recommendations as to accepted technical procedures. The new Manual 10 contains revised chapters on such basic topics as Triangulation, Traversing, Leveling, Topography, and Property Surveying; a new chapter devoted to the ever-growing field of Photogrammetry; and a new Appendix containing the different types of maps used in city planning.

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The EDO Model 255A

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The Model 255A employs a transducer which has a beam width of only 6 degrees at the 10 db point, which results in greater detail within a relatively small area. Lessening the penetration of signals into silt or mud gives extremely precise indication of the actual depth and contour of the bottom.

For measuring dredging operations, silt, sharp slopes, the Model 255A is recommended. For general survey, deep depth and penetration, the standard Model 255, with beam width of 20 degrees at the 10 db point and with accuracy within one-half of one per cent, is recommended.

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Notes can easily be made on chart through large hinged window or positions marked automatically with marker button. One roll of paper operates 10 hours continuously on "foot" scale; 20 hours on "fathom" scale. Equipment is housed in rugged cast aluminum case. Send for brochure today.

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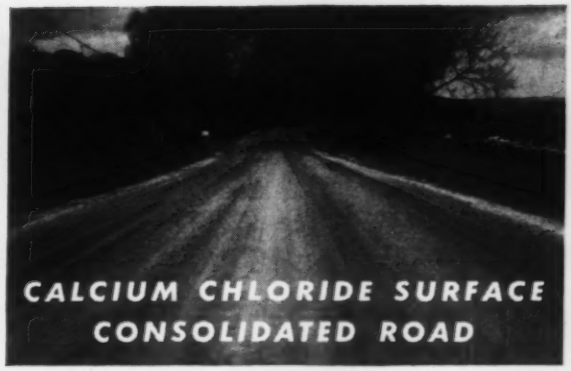

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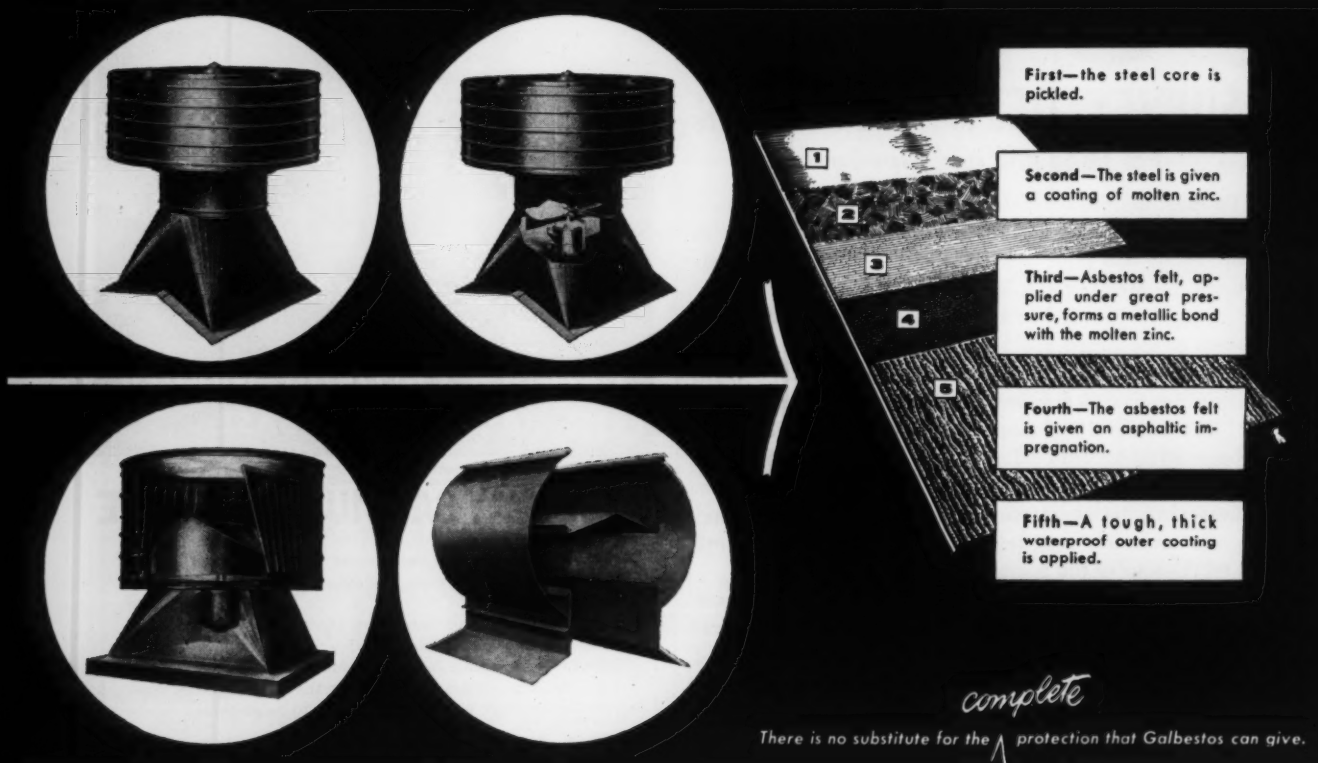
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1
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4
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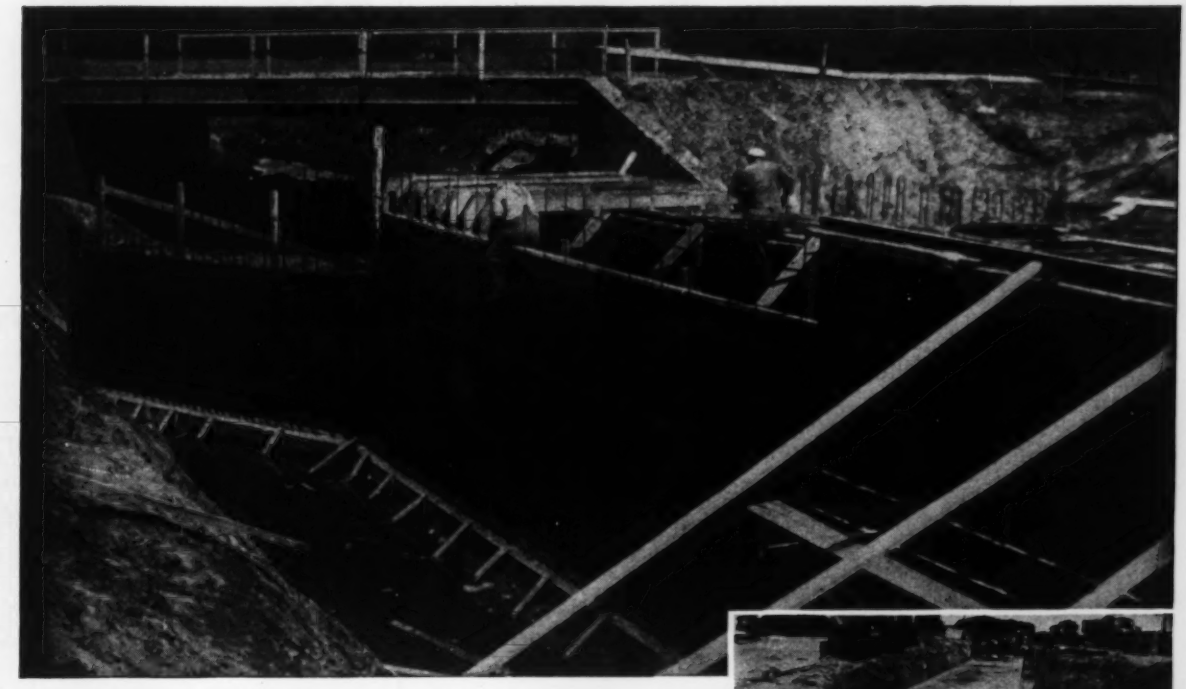

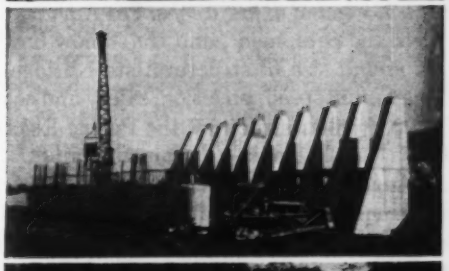

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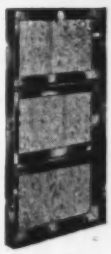

2. UNI-FORM Tie

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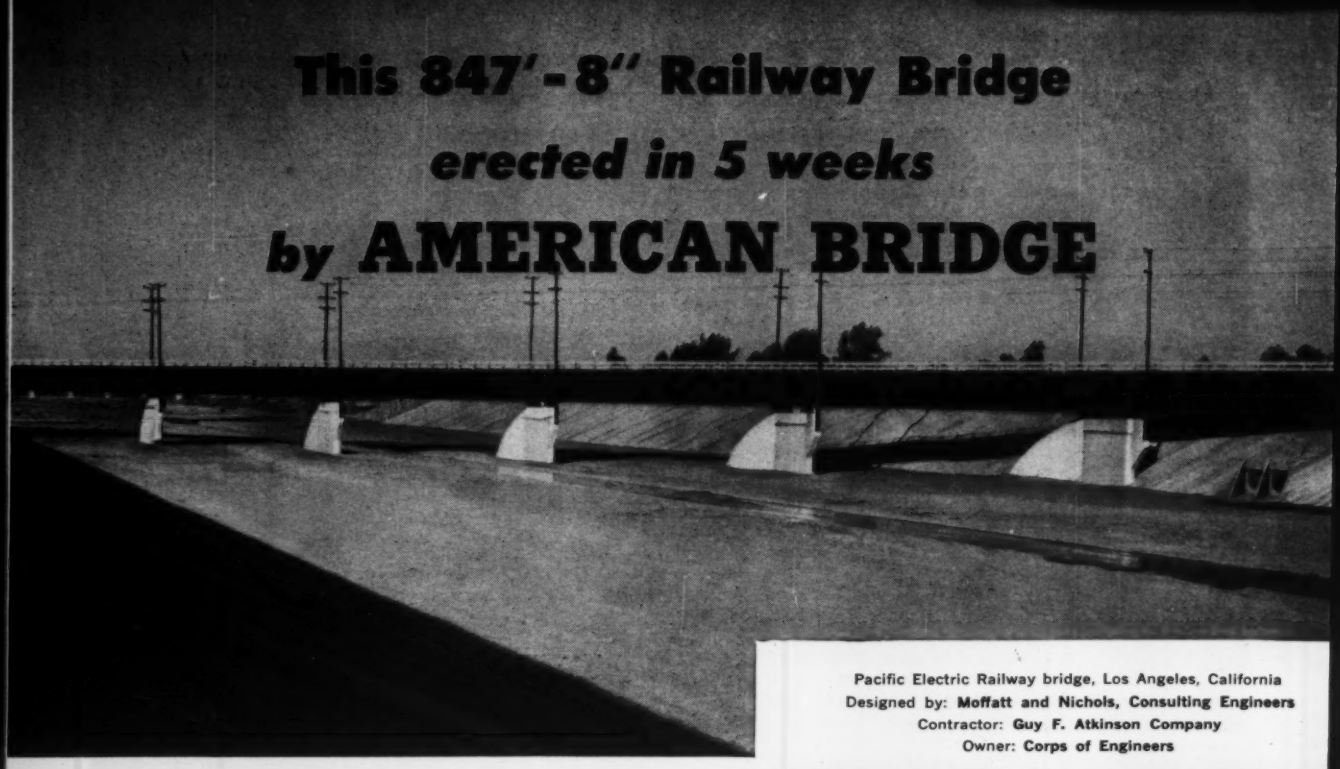
This 847′-8″ Railway Bridge *erected in 5 weeks* by AMERICAN BRIDGE



Pacific Electric Railway bridge, Los Angeles, California
Designed by: **Moffatt and Nichols, Consulting Engineers**
Contractor: **Guy F. Atkinson Company**
Owner: **Corps of Engineers**

THE RAILROAD BRIDGE shown above is just one of many built in the West in recent years by American Bridge. There is nothing unusual about this job— *not even the fact that it was erected in five weeks.* For American Bridge has the men, the equipment, and the "know-how" to handle any type and size of structural steel bridge or building with maximum speed, precision, safety and economy.

This particular structure, the Pacific Electric Railway bridge, is located between Dominiguez and Carson Streets in Los Angeles County. It is part of the Los Angeles River Improvement Project handled by the Corps of Engineers. 847′ 8″ long, it is made up of 7 single track plate girder spans: the first of which measures 114′ 8 7/16″; the next five, 123′ 8″; and the last, 114′ 8 7/16″. 832 tons of structural steel was involved, all of which was fabricated and erected by American Bridge.

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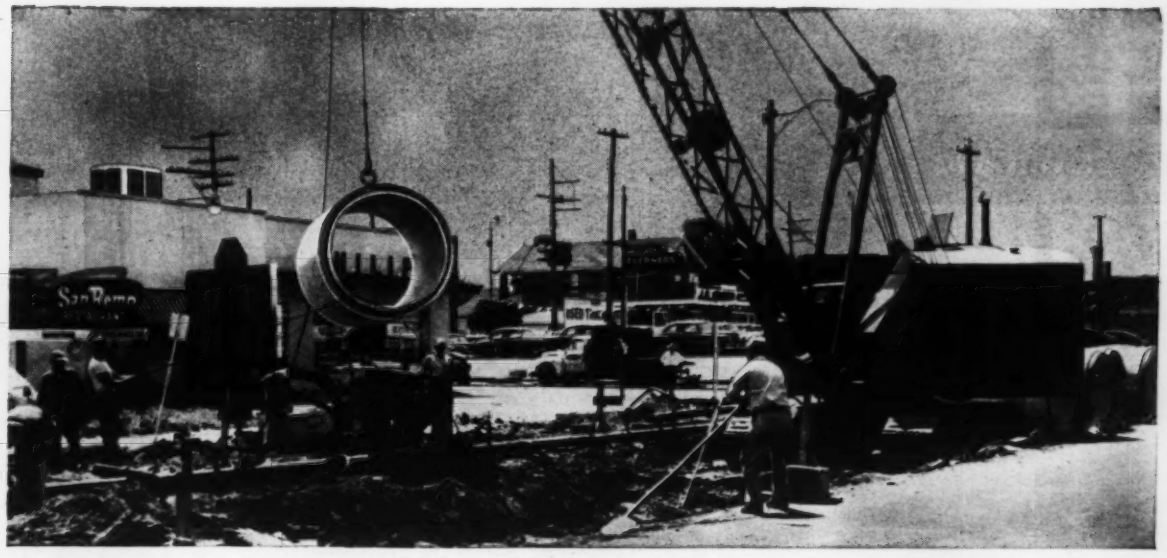
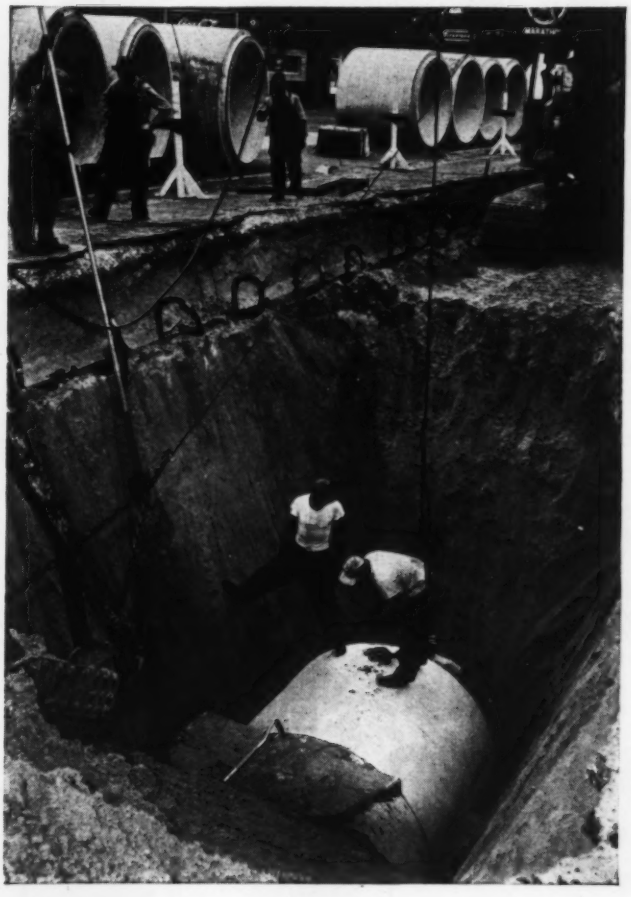


Above: South Broadway Interceptor
Below: Tolleston Area: Chase Interceptor; 25th Street Interceptor
Engineer: Hurst-Roche, Inc., Hillsboro, Ill.
Contr.: Witter-Gaddis Constr. Co., Schererville, Ind.

Rhode Island Interceptor (not shown)
Engineer: Hurst-Roche, Inc.
Contractor: Marsch Construction Co., Chicago



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chosen for Gary, Indiana $6,000,000 Sewer Project

To meet the needs of its expanding population, Gary, Indiana has invested $6,000,000 in new concrete interceptor and relief sewers.

The first project, a $2 million job, consisted of (a) an interceptor on Rhode Island Avenue using reinforced concrete sewer pipe ranging from 96″ to 132″ in size and (b) an interceptor on South Broadway requiring over a mile of concrete pipe ranging from 24″ to 84″.

The second project, the Tolleston Area: Chase Interceptor; 25th Street Interceptor, was a $4 million job. The Chase Interceptor required about 2 miles of reinforced concrete sewer pipe from 60″ to 132″ in diameter. The 25th Street Interceptor required one and one-half miles of concrete pipe ranging from 24″ to 84″ in size.

The 132″ pipe was the largest ever installed in northwest Indiana. Both projects were financed by bond issues.

Countless cities have learned that concrete pipe has rugged durability and great structural strength. It offers maximum hydraulic capacity, minimum infiltration and leakage and exceptional resistance to abrasion.

Concrete pipe sewers are moderate in first cost, require very little maintenance, and give a lifetime of faithful service. The result: *low annual cost.*

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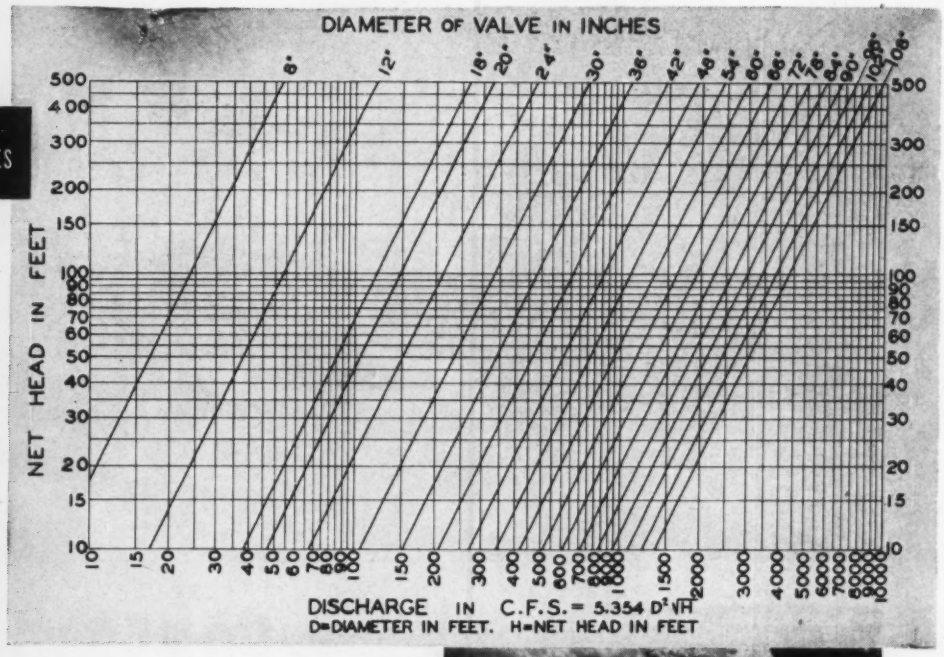

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SMS Howell-Bunger Valves provide easy regulation and control of water under free discharge. Tremendous amounts of energy can be dissipated with a minimum of erosion, cavitation and no vibration. Because of this valve's high discharge coefficient, pipe line or conduit size can be held to a minimum for economical construction.

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- Minimum cavitation and maintenance
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- Low initial cost
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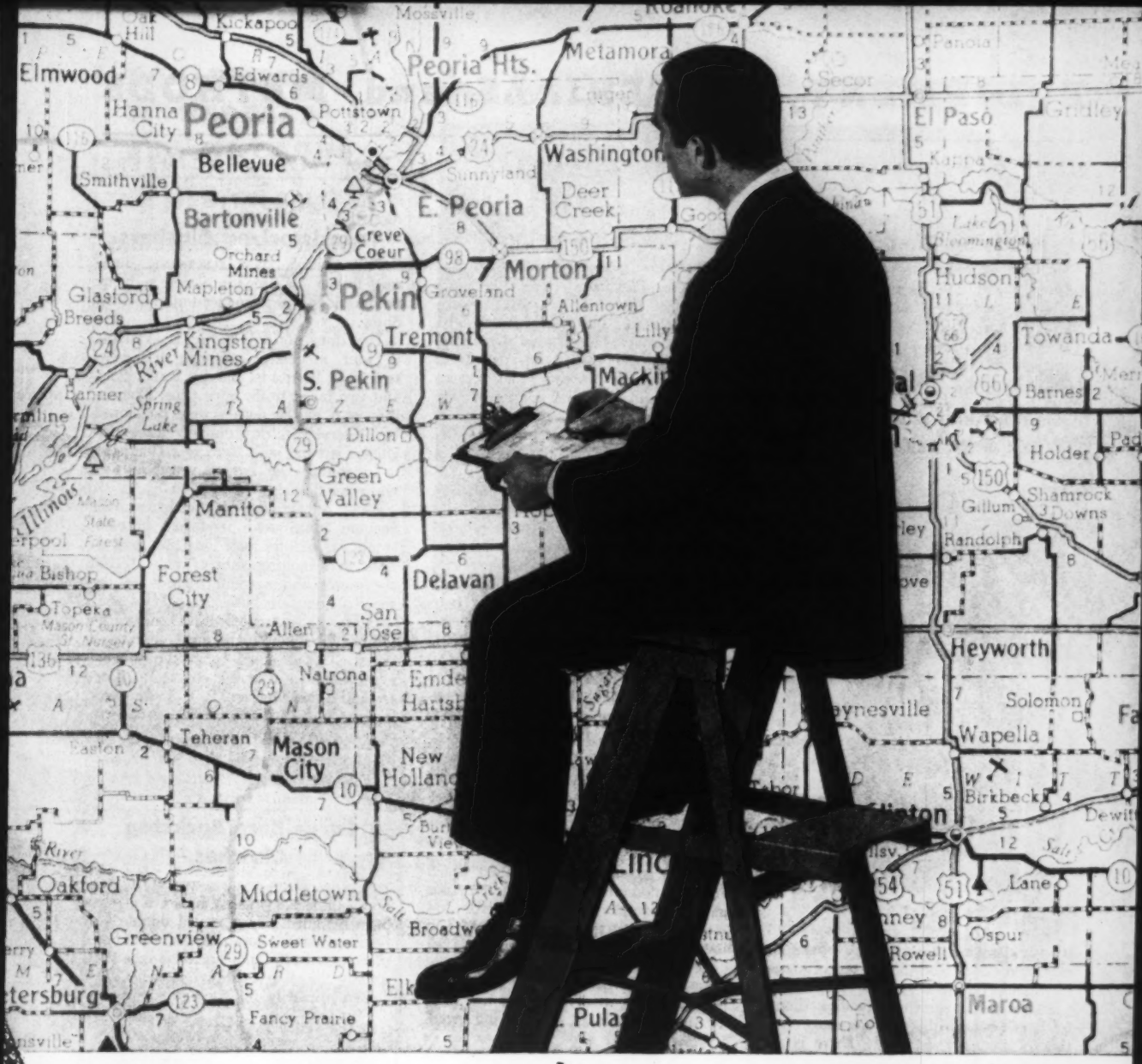
AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO



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NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

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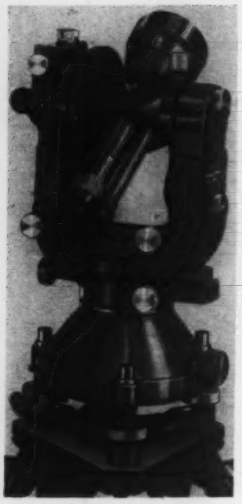

Wild T-3

Features include circle reading direct to 0.2 seconds, with telescope magnification of 24x, 30x, and 40x. There is no eccentricity error. The Wild T-3 is also finding an important place for ultra-precise measurements in industry and the laboratory. **Wild Heerbrugg Instruments, Inc., CE 5-136, Port Washington, New York.**

Swimming Pools

SOMETHING NEW AND DECIDEDLY practical for swimming pool construction has been developed. Concluding that the tongue and groove staves made in their own plant would serve as well in swimming pools as in silos and grain bins, the firm made a test and the results were more than satisfying. The advantages of the silo-stave construction are many: no building concrete forms are necessary, heavy precast sections are omitted and the size and shape—round or oval can be varied without adding extra cost. The depth can also be varied from wading pool to diving depth. **Memphis Concrete Silo Co., CE 5-136, 2677 Princeton Ave., Memphis, Tenn.**

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SINCE THE GLOBE COMPANY, manufacturers since 1914, first entered the grating field in 1950 with its Safety Grip-Strut grating, it has realized the need for an improved heavy duty open steel floor grating of greater strength and economy. It now presents Gold Nugget Welded Grating, the first grating to take advantage of modern engineering design. As a result of this improved design, the primary load bar, which is a miniature I-beam with all of the advantages of a true structural member, provides 22% more strength with 14% less weight. Features of this welded grating are; ⅜-in. projection weld nugget for greater rigidity and strength, vertical alignment of the main load bars assured, all bars are load carrying bars and an anti-skid pattern. It is recommended for power houses, loading docks, oil refineries, fire escapes, drain grates, plating rooms, filtration rooms and for all types of heavy duty platforms. **The Globe Company, CE 5-136, 4000 S. Princeton Ave., Chicago 9, Illinois.**

Concrete Form Panels

A NEW CONCRETE FORM method which completely eliminates conventional studs and walers has been perfected and proven over a three-year period. The new low-cost form, which consists of thick fir plywood panels and special fastenings, is designed to provide a sturdier, more easily constructed form for application on all types of industrial, commercial and residential forming as well as in bridges, reservoirs, culverts and manholes.

The panels are fitted with anchor nuts and edge-routed for form tie insert. The anchor nut is counter-bored into the plywood, so there is no protruding surface hardware until the panels are assembled. The formed, non-warp steel clamps which hold the panels together and are used in place of walers are quickly attached to the plywood at the job site by means of a cap bolt which screws into the anchor nut.

Inner or outer walls may be constructed separately or simultaneously. All panels are interchangeable in the FormCo method. As the concrete sets up, bottom panels may be easily detached and used to build a wall to any height. In addition, panels may be removed at any height for easier pouring access or inspection. The new assembly process is especially applicable to stepped-up footings, pilasters, columns and beams. **Douglas Fir Plywood Association, CE 5-136, 119 A St., Tacoma 2, Wash.**

Transistorized Flashers

THE WORLD'S FIRST ELECTRONIC highway flasher to use transistors is being produced. It was introduced at the Road Show.

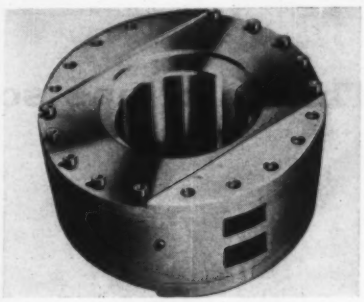
The transistorized flasher is available in four models . . . 360-deg barricade, two faced barricade, 360-deg traffic cone, and two faced traffic cone type. Transistors used in the flasher were developed by General Electric Company whose engineers worked with the Dietz Company in designing the circuits for the new electronic flasher.

Chief advantages of transistors over vacuum tubes used heretofore in electronic flashers are their long life, ruggedness, and requirements of only 1/1000 the power and a small fraction of the space of a vacuum tube.

In tests, transistors have shown no failures after 18,000 working hours at full power. This is equal to maximum load eight hours a day for six years. **Electronic Flasher Division, R. E. Dietz Company, CE 5-136, 225 Wilkinson Street, Syracuse, New York.**

Large-Bore Backstop Clutches

A NEW LINE OF OVER-RUNNING large bore clutches available in six sizes has been designed. These sealed double ball bearing clutches combine the advantages of compact size and lighter weight with greatly increased torque capacity. Designed primarily for back-stop purposes,



Available in 6 sizes

they are normally installed on the head-shafts of large conveyor systems. Other recommended applications are as back-stops for elevators and as dual drives for stand-by power applications and differential-speed drives. **Formsprag Company, Application Engineering Dept., CE 5-136, 23601 Hoover Road, Van Dyke, Michigan.**

EQUIPMENT MATERIALS and METHODS

(continued)

Bituminous Distributor

BITUMINOUS DISTRIBUTORS embodying a new principle of tank circulation and new "Duo-Flo" spray bar were unveiled in Chicago. Design of suction and discharge lines creates a constant circulation of material throughout the tank to protect material quality. The unique three-way circulation system provides complete tank circulation from end to end for uniform heating of material to required spraying temperature, parallel flow through bar when spraying for uniform pressure at every nozzle and series flow through spray bar when nozzles are closed to maintain tank temperature at bar and nozzles. Full tank circulation continues during bar circulation.

The Duo-Flo Spray Bar feeds material at tank temperature into both sections of the bar at equal pressure, thus maintaining material temperature and uniform pressure clear to the ends of the bar. Both lines from the tank feed the bar, creating a true parallel flow. The diameter of each bar pipe has been reduced, resulting in less material to flush.

Each nozzle is an integral part of the bar, and each nozzle has its own valve to maintain the nozzles at material temperature. Air-operated controls open or close nozzles simultaneously, in a split second. A full, uniform pattern is assured, even at low pressure. **Seaman-Gunnison Corp., CE 5-137, Milwaukee 15, Wisc.**

Michigan Line

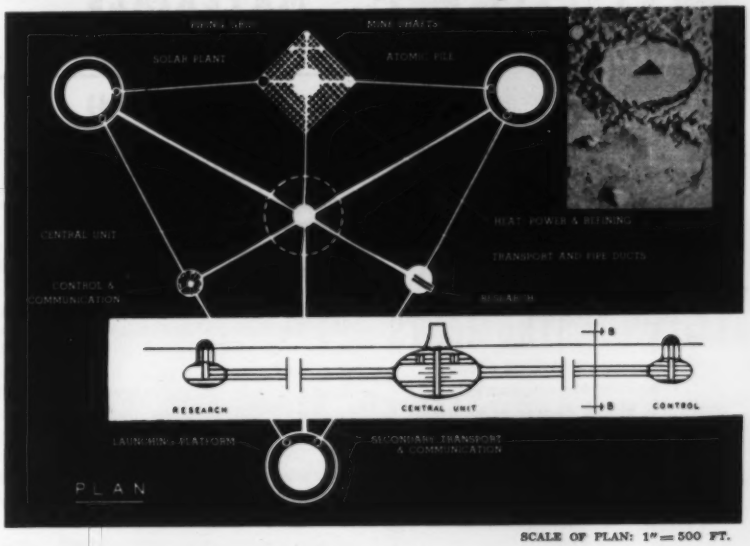
CLARK'S NEW MICHIGAN LINE offers you two major advantages:

(1) Because Clark designs and builds all drive components of every Michigan machine, you get power train efficiency unmatched in the earthmoving industry. The design of this power train is the same one Clark developed in 1954 for the first Michigan Tractor Shovel.

(2) Because Clark designed and engineered its entire big line at one time, you get a degree of interchangeability never before available. In each of the three size ranges of scrapers, tractor shovels, dozers and loggers, you have the same engine, the same power shift transmission, the same torque converter and planetary-wheel axles. In fleet operation, you get the great efficiencies of matched horsepower and matched speed. And you need far less than the ordinary spare parts investment.

The new line includes: two big Tractor Shovels, Model 375A; 6 cu yd with 930,000 lb lift capacity, Model 275A; 4 cu yd with 22,000 lb lift capacity, two dozers, Model 380 and 280 plus three scrapers, Models, 210, 310 and 110. **Clark Equipment Company, CE 5-137, 2427 Pipestone Road, Benton Harbor 1, Mich.**

MARS outstanding design **SERIES**



SCALE OF PLAN: 1" = 500 FT.

lunar base

Tomorrow's realities depend on research and imagination today. Both were used extensively in the planning of this lunar base designed by William G. Harvey, Jr. to accommodate space ships and travelers. The suggested location is "Aristotle," one of the craters near the north pole of the moon. Most of the base is beneath ground level to minimize temperature changes. Living quarters are spacious and recreational facilities include a swimming pool and basketball court. Power is supplied by solar plants during the day and atomic pile at night. Research, living and working areas are joined by monorail subway.

No one can be sure which of today's new ideas will become reality tomorrow. But it will be important then, as it is now, to use the best of tools when pencil and paper translate a dream into a project. And then, as now, there will be no finer tool than Mars—from sketch to working drawing.

Mars has long been the standard of professionals. To the famous line of Mars-Technico push-button holders and leads, Mars-Lumograph pencils, and Tradition-Aquarell painting pencils, have recently been added these new products: the Mars Pocket-Technico for field use; the efficient Mars lead sharpener and "Draftsman's" Pencil Sharpener with the adjustable point-length feature; and—last but not least—the Mars-Lumochrom, the new colored *drafting* pencil which offers revolutionary drafting advantages. The fact that it blueprints perfectly is just one of its many important features.

The 2886 Mars-Lumograph drawing pencil, 19 degrees, EXEXB to 9H. The 1001 Mars-Technico push-button lead holder. 1904 Mars-Lumograph imported leads, 18 degrees, EXB to 9H. Mars-Lumochrom colored *drafting* pencil, 24 colors.

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EQUIPMENT MATERIALS and METHODS

(continued)

Automatic Bucket Line

A NEW LINE OF LOWER COST "A" Series automatic dragline buckets with capacities from ½ to 3-cu yds recently introduced, features lighter weight, yet retains the rugged construction and automatic digging action for which Page dragline buckets are noted. The new Series has been released after exhaustive field testing in virtually every type of digging condition. Advanced design and construction principles provide important savings in weight over the heavier "R" Series Automatics, and permit matching the new "A" Series Buckets to some of the smaller dragline machines' lifting capacities for greater efficiency and production. Among the notable features incorporated in the new "A" Series Automatics are: a heavier, one-piece bottom plate—a new, improved lip—a two-position hitchplate—a smooth action dump block—flared sides—forward arch—reversible tooth points and heat treated alloy steel hoist and load chains. The "A" Series Automatics are available in Light-Medium, General Purpose, and Heavy Duty Classes. In all, the line comprises 33 buckets. **Page Engineering Co., CE 5-138, Clearing Post Office, Chicago 38, Ill.**

"A" Series

Conversion Factor Chart

A REFERENCE TABLE FOR engineers and other executives in Wall Chart form has been published. This Conversion Chart is amazingly useful for engineers, shop men and other executives. Included are common conversions such as inches to centimeters or watts to hp as well as many conversions that are difficult to locate in reference manuals. Some such examples are atmospheres to Kgs/sq cm, cm/sec to miles/hr, cu ft to liters, microns to meters, quintal to lbs, etc. **Precision Equipment Co., CE 5-138, 3716 N. Milwaukee Ave., Chicago 41, Ill.**

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CARL L. SHERMER. This book stresses the fundamental concepts of analytical determination of truss deflections; statically indeterminate trusses and beams; deflection of beams; rigid frames, arches, and rings; etc. Includes a unique chapter on graphical construction of influence lines, plus important data on plastic yielding. *200 ills., tables; 264 pp.* $6.50

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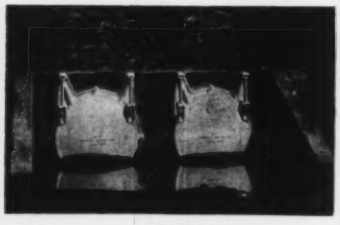


Fig. B-124-D

Two 60" Type M Gates on Relief Culverts near Woodward Pumping Station, Plymouth, Pa.

Fig. B-124-C

Two 72" x 72" Type M-M Gates on Toby Creek Outlet Works, Plymouth, Pa.

BROWN & BROWN, INC.
LIMA, OHIO, U. S. A.

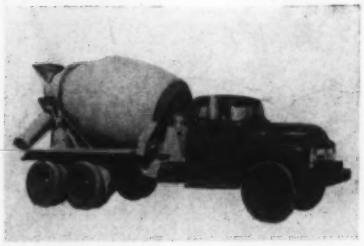
EQUIPMENT MATERIALS and METHODS

(continued)

Concrete Mixer

NEW 5 TO 7 C.Y. "MIXOMATIC" truck mixers featuring front engine power take off with Fordomatic transmission are announced.

An automatic transmission provides four discharge speeds allowing a greater flexibility of concrete flow and two levers, throttle and transmission, simplify the controls. The speed gear box and take-up drive chain are easily accessible for maintenance.



Mixomatic

Additional design and equipment features are the new hopper for faster charging, a three-way quick shut-off water valve and splash guards from fender to frame for drum protection. The use of standard automotive parts in the drive line makes service available everywhere.

The total weight of a 7 C.Y. truck mixer is approximately 6800-lb. **Willard Concrete Machinery Co., CE 5-139, 11700 Wright Road, Lynwood, Calif.**

New Insulating Links

AN INSULATING LINK WHICH eliminates the number one cause of electrocutions in crane accidents, over 60-per cent according to Public Utility Commission Reports, has been developed and perfected. The new Miller insulating links replace standard crane end connections with insulated connections capable of withstanding 100,000 volts. Crane booms or load lines accidentally coming in contact with energized overhead wires can no longer cause death or serious injury. To insure permanent, absolute safety, every single link is tested by a private Certified Laboratory, for 100,000 volts and the serial number of the link and report placed in a permanent file. The links are available for immediate delivery in both 6.8 and 8.5 ton sizes with various types of end connections. They will be available in a complete range of sizes in a very short time. **General Machine & Welding Works, Inc., CE 5-139, 1100 East Second Street, Pomona, Calif.**

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(continued)

Turbo-Charged Diesel Engine

A NEW TWO-CYCLE turbo-charged Diesel engine, 6-110 series, which adds 25 percent more horsepower, with no appreciable increase in bulk, weight, or operating cost was announced.

The engine is turbo-charged by utilizing its waste exhaust gases to drive a turbine turning an air impeller to supply a larger quantity of fresh air to the cylinders. The turbo-charger is combined with the engine's side-mounted blower to provide improved combustion, greater efficiency, and better high altitude performance, with no increase of fuel consumption.

The importance of this development, the manufacturer claims, is the urgent need to hold down road building costs, which is equalled by our need for more roads. He pointed out that the cost of producing the power for road building is probably the only area in which road building costs can be cut. **Detroit Diesel Division, CE 5-140, Detroit, Mich.**

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Electric motor operation is recommended for large M & H Gate Valves, or where valves are frequently operated, or where valves are located in remote, inaccessible or hazardous places. The remote control, possible with electric motor operated M & H Valves, is a convenience which frequently increases efficiency and reduces operating costs.
The 36" motor operated M & H Valve illustrated here is standard M & H Gate Valve design and construction—iron body, bronze mounted, double disc, parallel seat. All sizes of electric motor operated M & H Gate Valves are available in Class A for 50 lbs. working pressure, Class B for 100 lbs. working pressure or A.W.W.A. Class C for 150 lbs. working pressure. Furnished with hub, flanged or mechanical joint ends.
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Horizon Camera

A NEW 360-DEG HORIZON camera for recording vertical and horizontal images on 35 mm film has been announced. The camera is used for making horizon profiles to predict radar or micro-wave patterns in an area, or for plane table work or similar uses. The instrument incorporates a precise level line and is designed to permit very accurate measurement of azimuth angles, in spite of differential shrinkage of its record film or of photographic prints from the film.

The camera is available with a choice of lens and choice of scales for the azimuth angle. Current models use a 12-in. or 20-in. lens and have horizon scales of approximately 5-deg and 10-deg per inch. Set up and leveling for the horizon camera follows the same routines as setting up a surveyor's level. The camera turns through its 360-deg arc in approximately one minute, the speed of turning being pre-set to control the exposure time. The constant speed drive motor is operated by a 24 volt battery.

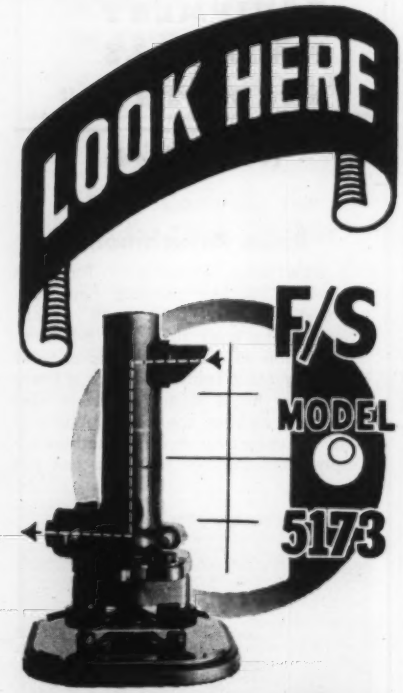
360 Degree Arc

Film capacity is approximately 400-ft, sufficient to survey about 60 sites. The film chambers are darkroom loaded but may be installed or changed in daylight, so different films may be used as required to penetrate ground haze. Infra-red and panchromatic are the principal types used. **Aero Service Corp., CE 5-140, 210 E. Courtland St., Philadelphia 20, Pa.**

Air Hose

A LENGTH OF TYPE 50 air hose, 220-ft long, 3 braids, and ¾-in. ID size, is used in an unusual way at Long Sault Dam on the St. Lawrence Seaway and Power Development. According to the Walsh Construction Company, sponsoring firm on the project, the hose conveys compressed air, which operates the remote

(Continued on page 141)



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- Viewing of bull's-eye level through telescope eyepiece.

ERECT IMAGE

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EQUIPMENT MATERIALS and METHODS

(continued)

controlled crane hook that picks up 12-ton buckets of concrete and carries them to the bulkhead where the concrete is dropped for laying. Inserted inside the hose is an electric cable that controls the air supply solenoid valve. Type 50 was selected for this duty because it takes the severe punishment of operating over two sheaves.

A popular general service air hose, Type 50 is made with heavy braided, high tensile rayon cord. It has a friction rubber coating between layers of fabric reinforcement that insulates the braids throughout the entire length of hose. This increases flex life, eliminates ply separation, cushions cords against impacts, and protects cords against moisture. **The B. F. Goodrich Company, CE 5-140 and 141, Akron, Ohio.**

Supervisory Control for Automation

DEVELOPMENT OF THE ROBOTEL controller, a signalling system which provides an alarm and record of the malfunctioning of any component in demineralizing equipment which is intended to operate in accordance with a predetermined program, is announced. It also provides for automatic shutdown of the programmed operation, if desired. The controller assumes that sooner or later a failure of a component will occur in any automatic control system. Depending on the nature and complexity of the system, such failure may be difficult to locate and correct promptly. In consequence quality control will be impaired. By means of this unit, the location of the function failure is immediately indicated, alarmed and recorded, thus locating the failure immediately and making possible its speedy correction. **Infilco Inc., CE 5-141, P. O. Box 5033, Tucson, Arizona.**

Nesting Table

A NEW PATENTED SPACE-SAVER folding table (Nesting table) which folds up into a shallow cabinet approximately 12-in. deep, is adaptable for drawing, painting, and general office and household use. The table supports and cabinet can be designed to accommodate most standard size drawing boards in general use by architects, engineers, draftsmen, students, artists and others. Provided with hinges and elevating devices the table permits the user to set it level or at a convenient angle in a matter of seconds. **Henry I. Cohen, C.E., P.E., CE 5-141, 811 Walton Ave., New York 51, N. Y.**

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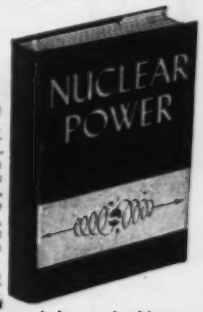

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EQUIPMENT MATERIALS and METHODS

(continued)

Rake Attachment

A NEW RAKE ATTACHMENT for Arps utility blades has recently been announced. Sturdily built with closely spaced spring steel tines, the 8-ft rake is obtainable at a low cost; the price of the utility blade frame and rake is lower than other rakes alone. Available also separately without the blade. Attached easily in only two or three minutes by simply removing two nuts and one pin

8-ft Rake

and sliding the tool into place, it may be angled either to the right or to the left, or in any one of eight positions. In an angled position, the rake will discharge materials in a window; in the normal position, it can be used for grading, leveling and mulching soil.

An optional gauge wheel is readily adjusted to maintain consistent depth penetration for land leveling operations. It can easily be detached when not required. **Arps Corporation, CE 5-142, New Holstein, Wisconsin.**

Pump

A NEW VARIABLE DELIVERY extra-high pressure axial multiplunger pump was announced by the manufacturer. The pump develops 5700 psi and is intended for hydraulic power applications. The oil delivery of this pump can be manually adjusted to any desired value (within available range) or can be left to vary automatically inversely with pressure-changes. This feature produces great savings in power, especially during holding stages of an operating cycle of presses of any kind, when only limited delivery is required to maintain the preset maximum pressure. These pumps are also well suited for any other operating cycle wherever substantially constant power is desirable during working periods. Sizes from 1½ to 30 hp are offered either as bare pumps or as package units as well. **Equi-Flow Div., Vibro Mfg. Co., CE 5-142, Woodside, New York.**

EQUIPMENT MATERIALS and METHODS

(continued)

New Controls for Ladder-Type Ditcher

DESIGNED FOR WATER MAIN and deep sewer excavation, the Model 160 ladder-type ditcher is now equipped with a hydraulic boom hoist for fast, positive positioning of the boom. The boom is raised, lowered and held by an independent, package-type hydraulic control system. No friction boom clutch or

Model 160

brakes are required. Double acting hydraulic cylinders provide full crowd for the boom. The 160 digs to a depth of 16-ft with widths from 18-in. to 48-in. Shiftable boom allows the 160 to work close to buildings, utility poles, streets and obstructions. Reverse digging speeds allow undercutting of sidewalks and pipes. **Gar Wood Industries, Inc., CE 5-143, Wayne, Michigan.**

GMC Trucks

SEVERAL HEAVY-DUTY GMC trucks designed especially for extremely efficient road building service have been exhibited recently.

Display trucks included 3 Dual-Purpose FW550 models with tandem-axles and 46,000-lb gross vehicle weights, and a tandem-axle model W674 with 63,000 GVW. One of the FW550's, exhibited in the Jaeger Machine Company display, had a front-mounted power take-off assembly that derives power from the truck's engine to run the 6½-cu yd concrete mixer mounted on the vehicle. By eliminating a separate engine with its own fuel supply to operate the mixer, the power take-off installation increases the truck's payload capacity by reducing its dead weight.

Besides increasing payload, the engine power take-off drive provides better vehicle weight distribution, reduces maintenance and operating costs, and permits more efficient mixer operation. **General Motors Corp., CE 5-143, 660 South Blvd. East, Pontiac 11, Mich.**

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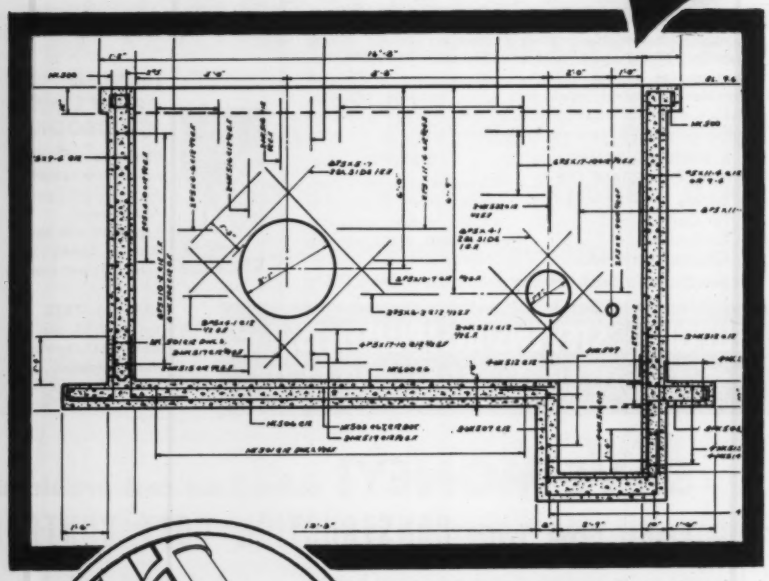

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EQUIPMENT MATERIALS and METHODS

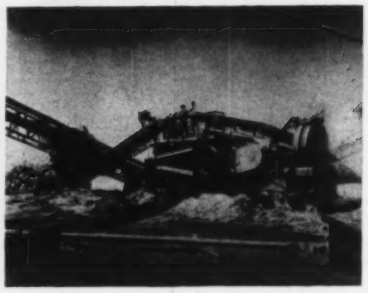
(continued)

Portable Plants

AN ENTIRELY NEW SERIES of portable duplex type gravel plants, designed to help contractors and producers meet construction needs of the vastly expanded highway building program, is now being manufactured.

Designated the 44V and 45V series, the new line consists of four plants, all having greater flexibility, higher capacities and more operating efficiency than has ever before been available in a portable gravel plant.

The 44V is equipped with a 3024 twin roll crusher and the 45V with a 4022 twin roll crusher. Both use a 1036 over-head eccentric jaw crusher, a bucket elevator for intra-plant material transfer and a



Specially Designed

new 4-deck 4-bearing vibrating screen, complete with secondary spring suspension mounting.

Through its flexible screening and spouting arrangement, plus availability of a full deck of scalping area ahead of the primary crusher and availability of a full deck of sand screening area, the new 4-deck, 4-in. x 12-in. screen allows high total production of one, two, three or four sizes of closely graded product.

Both the 44 and 45 plants are available with electric drives, if desired. When so equipped, model numbers become 44VE and 45VE. On electrified models, only the jaw and the roll crushers are mechanically driven, all other units being driven by individual electric motors. **Pioneer Engineering Works, Inc., CE 5-144, Minneapolis, Minn.**

Trenching Machines

THESE TRENCHERS are the machines that dig the vast and complex systems of pipelines that have become the life of our modern civilization, the underground arteries that carry water, gas and oil, electricity, communications lines and now, even coal from the places where nature has stored them or from their

(Continued on page 145)

EQUIPMENT MATERIALS and METHODS

(continued)

man-made points of origin to our homes and factories and farms where they are put to hundreds of different uses.

These same machines dig the water drainage systems required for our modern highways and for airports, parking areas, industrial and commercial and residential building sites as well. They are employed directly in highway widening work. One of these Cleveland machines, a standard factory-equipped model, in a single "pass" accurately makes the "cut" required for widening the road bed, leaving it perfectly excavated, straight, smooth and clean, ready for the paving operation, with no further excavation work required. Trenchers also dig the drainage and irrigation systems required by our farmlands for high crop production with a minimum of farm labor. They dig the house footings trenchers required for the foundations of modern, basementless homes. They dig the sewer systems that carry away all the wastes of our complex modern way of living and working. The trenches dug by these machines are of all sizes and types. They may be thousands of miles or just a few feet in length, many feet or only a few inches in depth and width. The "big inch" oil and gas lines that criss-cross the continent from one corner to the other are often dug down to 7½-ft deep and up to 4½-ft wide. Sewer lines sometimes require trenches 12, 14 or 18-ft deep. **Cleveland Trencher Co., CE 5-144 and 145, 20100 St. Clair Ave., Cleveland 17, Ohio.**

Torque Converter

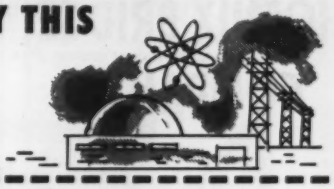
REPRESENTATIVE MODELS of its complete line of friction and fluid drives for powered equipment were exhibited at the Road Show.

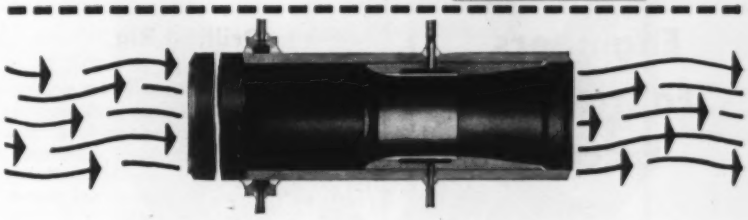
The new 1500 Series Single-Stage Torque Converter is designed for shovels, front-end loaders, bucket loaders, industrial lift trucks and other applications where single-stage characteristics offer certain advantages.

This addition to the line is applicable to engines producing from 30 hp at 1100 rpm to 207 hp at 2500 rpm. Impellers are available for specific torque ratings of 165, 200, 240, 285 and 330-lb ft. It is currently available with clutch input, spider drive input, flange input and output, and as a spacer-type unit with double-ended SAE housings.

Other major equipment manufacturers also exhibited heavy-duty machines incorporating Twin Disc industrial power transmission products which included torque converters, fluid couplings, fluid power take-offs and friction power take-offs. **Twin Disc Clutch Company, CE 5-145, Racine, Wisconsin.**

PRODUCTIVE ATOMS POSED A "HOT" METERING PROBLEM... SOLVED BY THIS BUILDERS FLOW NOZZLE!!





This Flow Meter is in the primary loop of every major atomic reactor in America — from the Nautilus to the Shippingsport Power Plant.

- Only flow nozzle offering the accuracy, range, low head loss, freedom from upstream disturbances, and other desirable characteristics of the Venturi Tube.
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  Designed for high temperature — high pressure applications (power plants, high pressure lines, atomic reactors, etc.).
- Nozzle can be factory inserted in any customer-supplied high cost, special pipe at considerable savings.
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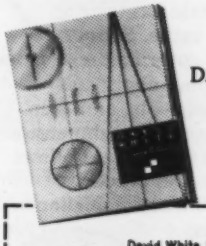

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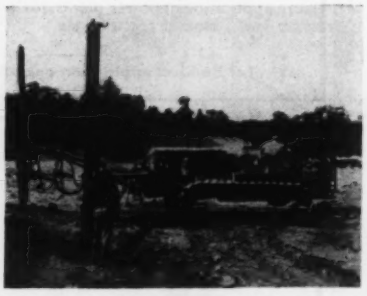
EQUIPMENT MATERIALS and METHODS

(continued)

Drilling Rig

THE AVAILABILITY OF A NEW Blue Brute tractor-mounted drilling rig for production blast hole drilling on rock excavation projects, quarrying, ditching, and open-pit mining has been announced. It is a completely self-contained unit carrying its own air supply and driven either by the tractor engine or a cross-mounted portable. The two hydraulically controlled jibs can be operated through a total arc of 100-deg vertically or horizontally. The boom can be extended for any distance up to 5-ft providing a large drilling area and making it possible for more blast holes to be drilled from one location than conventional equipment which must be located after each blast hole is drilled. Special features include the Standard Blue Brute UM-40 chain feed and drifter assembly for fast drilling, low air consumption and economical performance; exclusive positive, long-wearing, oversize hydraulically-operated clutch between compressor and tractor PTO; and simple, positive-locking hydraulic controls to effectively maintain position of drill. **Worthington Corp., Adv. & Sales Promotion Dept., CE 5-146, Harrison, N. J.**

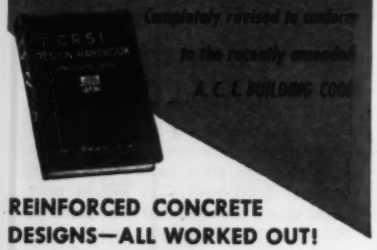


New Blue Brute

Fluorescent Cardboard

AN INTERESTING USE OF Velva-Glo fluorescent red cardboard was discovered recently. The Flood Control Office, Santa Rosa, Calif. is using 2 x 3-in. squares of this cardboard as surveying targets by the crew that is doing the survey work on the first Aqueduct which is to bring water from the Russian River to the city. **Radiant Color Company, CE 5-146, 830 Isabella St., Oakland 7, Calif.**

NEW EDITION!



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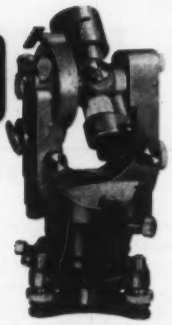

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By day or underground, this WILD Instrument offers unprecedented advantages

From its optical excellence to its mechanical precision the T-1 has earned a world-wide reputation for great performance. Users everywhere praise the instrument for its rapid set-up, high accuracy and virtually unlimited versatility!

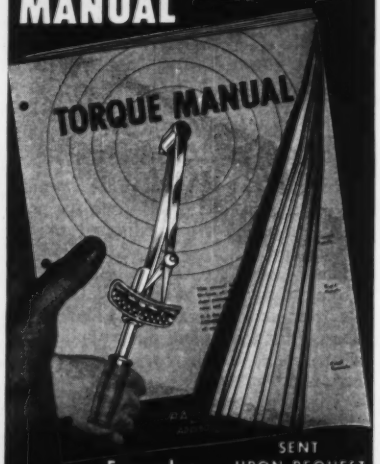
NOTABLE FEATURES OF THE WILD T-1

- Reads direct to 20 seconds with interpolation to 10 seconds, on both horizontal and vertical scales.
- More than a dozen accessories are available for quick, simple, accurate solution of routine and special problems.
- Built-in illumination for both circles, scale and reticle.
- Rugged, precision construction throughout.

PRICE: $718; f.o.b. Port Washington, N. Y. Tripods extra. Write for Booklet T-1.

WILD HEERBRUGG INSTRUMENTS, Inc.

"TORQUE WRENCH" MANUAL



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Literature Available

ENGINEERING INSTRUMENTS—The first completely revised catalog of engineering instruments in fifteen years has been published. The Gurley engineering instruments catalog has been published since 1855, and has achieved the status of a reference work among engineers and surveyors and students of engineering. A number of new explanatory tables are a feature of the 72-page book, which has been printed in two-colors. The tables make it possible to locate detailed information at a glance. Recent models of instruments, such as the Model OP-57-20 Optical Plummet Transit, are described in detail, as are many of the features of Gurley instruments such as reversion levels, variable power eyepieces and covered glass reticles. Among the Sections in Bulletin 50 are: Transits, Levels, Leveling and Stadia Rods, Topographic Instruments and Equipment, Compasses, etc. The new Bulletin 50 is available to practicing engineers, surveyors and students of engineering who request it by letter. **W. & L. E. Gurley, CE 5-147, Troy, N. Y.**

BETTER CONTROL, ELECTRICALLY—How to determine the selection of proper controls for heating and ventilating systems in todays modern schools and colleges is discussed and illustrated in non-technical language in a new 16-page booklet, F 7773, recently issued. Illustrated with photographs and diagrams, the booklet covers the control of convector systems, direct fired warm air systems, zone systems, unit ventilators, and the application of Control Centers for simplified installation and operation. **Barber-Colman Co., CE 5-147, 1300 Rock Street, Rockford, Ill.**

CONTROL OF DUST—A bulletin just issued tells how cement plants can suppress dust at its source before it can rise in the atmosphere. It shows, by copy and illustration, how to achieve dust-free handling of rock, coal and clinker at truck dumps, crushers, screens, bucket elevators, conveyor transfer points, and at boat loading and unloading docks. Advantages of the system, known as Chem-Jet, are outlined along with an explanation of how it works. Details are given about the essential equipment and Compound M-R surface active agent used with the system. **The Johnson March Corporation, CE 5-147, Philadelphia, Pa.**

DOOR OPERATOR MOTORS—Bulletin GEA-6299, four pages, gives application and design features on door operator motors ⅛-hp through ¾-hp for commercial, industrial, and domestic applications. Illustrated bulletin contains information on application engineering aid offered. **General Electric Company, CE 5-147, Schenectady 5, New York.**

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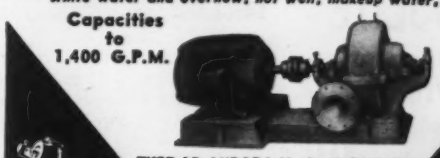

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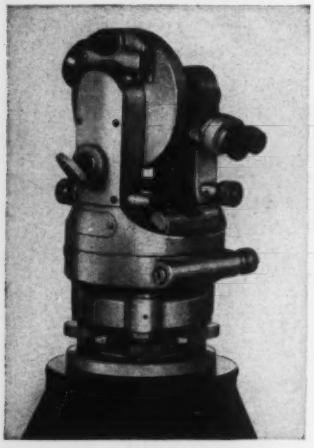

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Literature Available

AIR REDUCTION—A 12-page reprint entitled, "Power Supplies for Gas Shielded Metal Arc Welding" by A. Lesnewich and E. Cushman of the Air Reduction Research Laboratories, Murray Hill, New Jersey, is now available. Reprinted from the Welding Journal, this paper details a study which indicates that a constant-voltage transformer-rectifier with automatic regulations for fluctuations in line voltage is the best general purpose machine for the inert-gas-shielded metal arc welding process. **Air Reduction Sales Company, CE 5-148, Division of Air Reduction Co., Inc., 150 East 42nd Street, New York 17, N. Y.**

NEW PRODUCTS BOOK—A comprehensive new book containing detailed information on the entire line of Solvay Alkalies and Chemicals has been announced. This "Products Book," as it is called, contains informative data on the uses, markets, physical and chemical properties, packaging and handling and storage of the line. Also included is a listing which groups the products by consuming industries or manufacturing processes. The book is illustrated with photos of buildings and manufacturing operations at the various Solvay plants. Department PB, **The Solvay Process Division, CE 5-148, Allied Chemical & Dye Corporation, 61 Broadway, New York 6, N. Y.**

NEW TYPE WATERSTOP—Manufacturers of "Durajoint" and "Duraseal" PVC Waterstops announce the availability of a new Technical Report No. 1 that summarizes the tests made to determine how design of the cross-section of a waterstop affects the bonding of the waterstop to concrete. This report is not a sales piece but contains the complete text of the test report submitted by an independent testing laboratory, plus photographs of the test procedures and results. It provides very accurate and conclusive facts on the "holding-power" of various designs of waterstops and should be a valuable addition to the library of every architect and engineer interested in the use of waterstops. **W. R. Meadows, Inc., CE 5-148, 7 Kimball Street, Elgin, Ill.**

BENDIX COMPUTER—A 6-page illustrated bulletin describing the Bendix G-15D general purpose digital Computer and its digital differential analyzer accessory is now available. The versatility and range of operations of the basic Bendix G-15D are considerably increased by the addition of this optional accessory. Linear and non-linear differential equations are solved accurately and rapidly with the two units. New programming techniques and a complete new line of input and output equipment are also described. **Bendix Computer Division, Bendix Aviation Corp., CE 5-148, 5630 Arbor Vitae Street, Los Angeles 45, Calif.**

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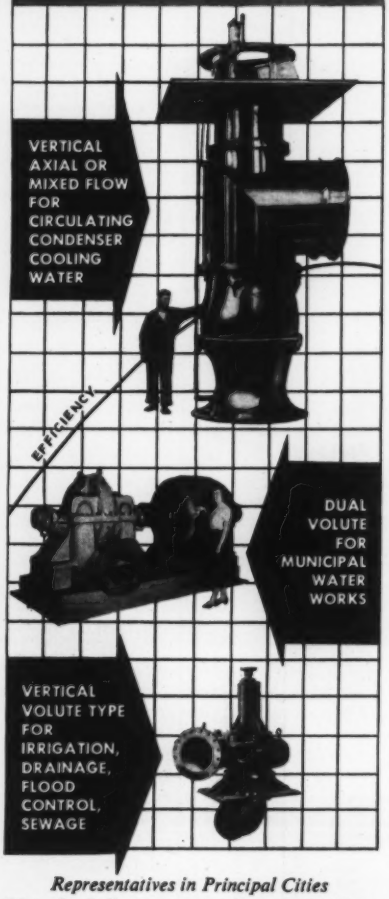
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Films Available

"Cold Welding"—A new 16-mm sound movie and 10-min documentary account of maintenance welding operations at Thule Air Base, Greenland, has been produced. The new film depicts the activities of several Welding Technicians who were flown to "the top of the world" following a request by the Air Force that Eutectic provide on-the-spot recommendations for repairing Diesel generator cylinder walls and other heavy equipment vital to the operation of this northernmost outpost of the Free World. The use of their "Low Heat Input" metal-joining and repairing process at Thule is shown. "Cold Welding" procedures for repair of the Diesel engines, for 350 cylinder liners delivered in Thule and for such applications as repair of Diesel engine radiators and aircraft fuel tanks are featured. **Eutectic Welding Alloys Corp., CE 5-149, 40-40 172nd Street, Flushing 58, N. Y.**

"Highway Life Lines"—A new film depicting the best methods for selecting and applying traffic paints is now available. The 16-mm film is in sound and color and runs for about 16-min. Against a backdrop of colorful highway scenes from coast to coast, the film covers subjects such as methods of evaluating traffic paints; factors influencing paint performance; and various methods of applying traffic paints. Using "Parlon" base traffic paints, as an example, the film points out that the selection of "Highway Life Lines" has become a science and that the performance and cost of outstanding traffic paints, on various types of surfaces, can be realistically predicted. **Advertising Department, Hercules Power Co., CE 5-149, Wilmington 99, Delaware.**

"Standardization For The Long Haul"—a new documentary film on the employment of belt conveyors in all sorts of major construction and aggregate producing applications, has just been announced. The film, a 16-mm in sound and color, runs approximately one-half hour and is well suited as a program feature. Among the many major jobs portrayed in the film are those involving the production of aggregates or the handling of wet concrete for the building of Folsom Dam; the Barnhart Island Power Plant of the St. Lawrence Seaway project; Oahe Dam (which sequence includes some unusual underground scenes); Chicago's mammoth underground Randolph Drive parking lot and its Lake Calumet Port facilities. **Barber-Green Company, CE 5-149, 400 N. Highland Ave., Aurora, Ill.**

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DGH-100 Portable Differential-Acting PILE HAMMER

Put this versatile DGH-100 Hammer to work on any job you have ★ you'll be amazed at the number of jobs it can handle ★ operates on compressed air or steam ★ delivers a rated striking energy of 386 pounds ★ just over 4 feet long it is readily moved about in a jeep. Illustrated here is the DGH-100 Hammer being used with a LeRoi Tract-Air breaking concrete curbing.

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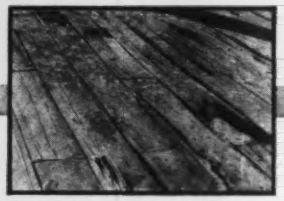

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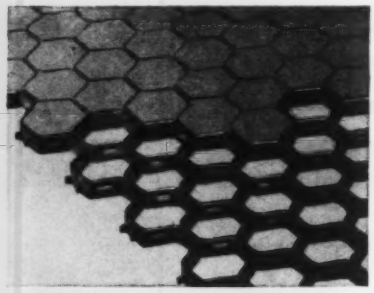

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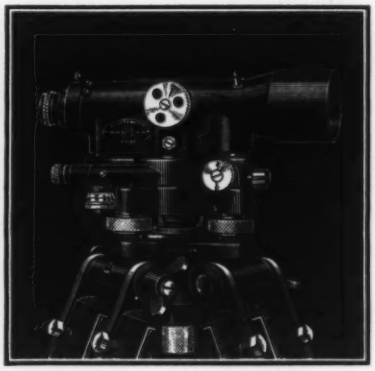
From the MANUFACTURERS

PLANNING SURVEY: A new program to aid industrial firms in selecting the correct spectrographic equipment for their needs has been announced by the Bausch & Lomb Optical Co., Rochester, N. Y. Under the plan, known as the Analytical Planning Survey, spectrographic experts will make a complete study of a firm's requirements and recommend suitable equipment on the basis of their findings . . . **TABLET HYPOCHLORINATOR:** Fischer & Porter Co., Hatboro, Pa., instrument and chemical equipment manufacturer, has acquired from Olin Mathieson Chemical Corp. all sales, development and manufacturing rights to the HTH Tablet Hypochlorinator, according to an announcement by the two companies. The tablet was developed in 1951 and is a device for the continuous generation of chlorine solution from calcium hypochlorite tablets . . . **SCHOLARSHIP:** Blaw-Knox Co., Pittsburgh, Pa., has announced details of a scholarship program in which children of all employees, except company officers, may compete. The program provides an annual grant of 4 scholarships covering 4 years' study in engineering or science, with a scholarship assigned to each of four universities—Carnegie Institute of Technology, University of Pittsburgh, Lehigh University and Purdue University . . . **MOVING SIDEWALKS:** Chicago Transit Authority commutors are getting a "lift" these days out on Chicago's south side by means of a conveyor belt, or moving sidewalk. It has a capacity of 7200 persons per hour, a belt speed of 125-ft per minute and is set on an inclined plane of 15 degrees. Built and installed by Stephens-Adamson Mfg. Co., Aurora, Ill. . . . **$50 MILLION MILE:** Boston is spending $50 million to build the most expensive mile of highway on earth which is a part of an inner belt route that feeds traffic in and out of the city in a north and south direction. Looped around a series of man-made belts, it will sit on stilts on one end and sink at the other into the widest tunnel in the world—91½-ft from wall to wall. 14 Worthington Corp., Harrison, N. J., 6½-cu yd Hi-Up truck mixers will deliver approximately 120,000 cu yd of concrete at a cost of about $8,700 per foot . . . **CANADIAN DISTRIBUTOR:** A joint announcement has been made by The David White Instrument Co., Milwaukee, Wis. and Sperry Gyroscope Ottawa Ltd., to the effect that the latter has been appointed sole distributor of David White Surveying Instruments . . . **NEW DISTRICT OFFICE:** Reliance Steel Products Co., McKeesport, Pa. announces the opening of a district office at 250 East 43 St., NYC. John Karboska has been appointed district manager.



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April

1196. Bending of a Rectangular Plate with a Free Edge, by William Nachbar. (EM) A rectangular plate, simply supported along three edges and free on the fourth, is subjected to linearly varying lateral pressure. Extensive, exact numerical results are given for deflections, moments, shear and edge reaction force distributions for various geometries and different Poisson's ratios. Approximate, closed form formulas are also developed.

1197. Mechanics of Sediment Ripple Formation, by H. K. Liu. (HY) Literature on the mechanics of sediment ripple formation is reviewed. It is shown in this paper that ripples are caused primarily by the instability of the zone of high velocity gradient at the surface of the sediment-laden bottom. For practical application an experimental criterion is given to predict the formation of sediment ripples and dunes.

1198. Characteristics of a Large Throated Syphon, by J. C. Stevens. (HY) A syphon spillway, having what is believed to be the largest throat dimensions (9.0 ft by 35.6 ft), was designed and piezometrically tested by the author. The paper gives its discharge coefficient, efficiency, primary behavior, and other data. It maintains a constant forebay level at the Portland General Electric Company's Sullivan plant regardless of ordinary floods and load variations.

1199. Ocean Wave Forces on Circular Cylindrical Piles, by R. L. Wiegel, K. E. Beebe, and James Moon. (HY) Forces exerted by ocean waves on circular cylindrical piles were measured at an exposed location near Davenport, Calif., in water 50 ft deep. The waves were as high as 20 ft. The coefficients of drag and mass obtained from these measurements are given, and the significance of their scatter, discussed.

1200. The Estimation of the Frequency of Rare Floods, by Benjamin A. Whisler and Charles J. Smith. (HY) A method of estimating the frequency of annual peak flood flows which uses recorded monthly peak flood flows is suggested. It is shown that the use of monthly peak flood flows approximates the results obtained by using all peak flows but greatly reduces the amount of work involved.

1201. A High Head Cavitation Test Stand for Hydraulic Turbines, by W. G. Whippen and G. D. Johnson. (HY) This paper presents a description of a new closed-circuit "water tunnel" and indicates its value for testing model hydraulic turbines under high heads (up to 300 ft).

1202. Is the Writing of Flood Insurance Feasible, by John F. Neville. (HY) This paper discusses flood insurance from the standpoint of the private insurance industry; reviews the efforts made by private industry to provide such coverage in the past; explains why privately sponsored flood insurance is unfeasible; and reviews the offer of the industry to assist in putting into effect the Federal Flood Insurance Act of 1956.

1203. Infiltration Measurements in Sewers of Small Size, by Robert A. Lincoln. (SA) A rapid and accurate method of measuring groundwater infiltration flows in newly constructed sanitary sewers of small size is discussed. A description is given of the design, fabrication, and calibration of rectangular slit and sutro proportional weirs developed for use on a certain project before the project was placed in service to handle sanitary flows. Use of the apparatus in the field is described.

1204. Field Experiences with Chemical Grouting, by Milos Polivka, Leslie P. Witte, and John P. Gnaedinger. (SM) Many examples are cited of the use of chemical grouts, either to improve the stability of sandy soils or to seal porous strata. They include the use of sodium silicate grouts in constructing tunnels and foundations in free-flowing sand, experience with chrome-lignin grouts at Heart Butte Dam, and experiences with calcium acrylate and acrylamide methylene bis acrylamide grouts. Laboratory control, composition of grouts, and methods of grouting are discussed.

1205. Compacting Earth Dams with Heavy Tamping Rollers, by Jack W. Hilf. (SM) The results of compacting 39 Bureau of Reclamation earth dams by heavy tamping rollers are compared with the laboratory standard compaction test. A statistical method obtaining roller curves from control tests made during construction is presented. The results of this type of analysis on three dams which represent a wide range of impervious soils are given.

1206. An Estimation of the Point Resistance of a Pile, by Yoshichika Nishida. (SM) This paper presents a new method for computing approximately the bearing capacity of a foundation pile by its point resistance in cohesionless soils. Although it is not rigorous from the mathematical point of view, the method seems to give a good estimation of the bearing capacity of a pile after comparing it with practical examples.

1207. Use of Material from Structural Excavations, by Jack W. Hilf. (SM) The design of a rolled earth dam may be influenced significantly by materials available from excavations for appurtenant spillways, outlet works, and power plants. The magnitudes of these excavations for 32 major dams designed by the Bureau of Reclamation are listed with three examples of their influence on embankment design.

1208. Rivers Under Influence of Terrestrial Rotation, by Otakar W. Kabelac. (WW) The mathematical evaluation of forces involved in the formation of river beds, according to the Law of Baer, is outlined. The mathematics of this paper is based on the principle of dynamics regulating the Coriolis Force, which is created by a mass moving in a rotating system. In the given case the mass is the mass of river flow moving on the surface of the rotating earth.

1209. Flood Control Plan for the Ohio River Basin, by Bruce R. Gilcrest, Emil P. Schuleen, and Edgar W. Landenberger. (WW) The present flood control project for the Ohio River Basin is described. The hydraulic and economic effectiveness of the completed portion of the project is presented. The need of continuing the work is discussed in view of the expanding economy of the basin.

1210. Laboratory Study of Wind Tides in Shallow Water, by O. J. Sibul and J. W. Johnson. (WW) Wind tides and wave conditions in shallow water were studied in a laboratory channel with wind velocity and bottom roughness being the principal variables. Water-surface profiles and data on the relationship between bottom and surface shear forces are presented.

1211. The Littoral Drift Problem at Shoreline Harbors, by J. W. Johnson. (WW) A

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harbor which fronts directly on an open shoreline and has a relatively small flow is defined as a shoreline harbor. For such harbors, where a littoral drift occurs along the shoreline, certain design, construction, and maintenance problems exist. This paper summarizes some of these basic considerations and presents a few case histories of typical shoreline harbors.

1212. Plate Buckling in the Strain-Hardening Range, by Geerhard Haaijer. (EM) Stress-strain relations for the strain-hardening range of structural steel are derived and applied to the plate buckling problem. The corresponding orthotropic behavior of steel is described by effective moduli, taking into account the influence of initial imperfections. Agreement between theoretical and experimental results justifies such an approach.

1213. Inelastic Response of Columns to Dynamic Loadings, by B. J. Hartz and Ray W. Clough. (EM) A method is proposed for determining the response of pinned-end columns to compressive loadings of arbitrary time history when the deformations of the column extend into the inelastic range. Numerical methods are used to integrate the equations for the elastic and inelastic response. The results are compared to the experimentally determined response of an actual column.

1214. Some Contributions to the Wedge-Water Entry Problem, by Sidney F. Borg. (EM) The paper presents some of the results of a study of the wedge-water entry problem based upon a new formulation of the basic equations of hydrodynamics applicable to this problem. Exact and approximate solutions (and some experimental results) are given for various straight-sided and blunt-nosed wedges.

1215. Fly Ash Concrete for Shippingport Atomic Power Station, by Robert J. McAllister. (EM) About 15,000 cu yd of fly ash concrete using type IS Portland Blast Furnace slag cement have been placed at the Shippingport Atomic Power Station. This paper deals with the ways in which the solution of many problems was accomplished, with particular emphasis on the development of a mix designed to attain a compressive strength of 3,000 lb per sq in. at 28 days.

1216. Water-Hammer Design Criteria, by John Parmakian. (EM) A design criterion for including the effects of water hammer in turbine penstock and pump discharge line installations is outlined. Various possible conditions of operation are enumerated, and suitable factors of safety are assigned to each contingency. Typical examples are included.

1217. Arch Dams: Review of Experience, by Robert E. Glover. (PO) The review presents records of the performance of some of the older arch dams to learn how well they had served the purposes of their designers. The records are presented in tabular form, supplemented by notes and pictures.

1218. Sanitary Engineering Education: Its Evolution, by Harvey F. Ludwig, Edmund J. Laubusch, and Erman A. Pearson. (SA) Sanitary engineering education has been undergoing a steady evolution over the past 65 yr to meet the demands of a changing technology. The present trend is toward graduate level training with uniform standards of education becoming a necessity.

1219. Sanitary Engineering Education: General Requirements, by Daniel A. Okun. (SA) Sanitary engineers must be educated to meet modern challenges. The many areas of science preparation and the desirability of development through a major branch of engineering, preferably civil engineering, require that sanitary engineering education be on a graduate basis, with a faculty strong in the sciences. Sanitary engineers on undergraduate engineering faculties have an opportunity to recruit to the field.

1220. Sanitary Engineering Education: Needs in the Southeast, by John E. Kiker, Jr. (SA) The sanitary engineering needs have been very great in the southeastern section of the United States. In order to meet these needs there has been an increase in the sanitary engineering education in the colleges and universities in this area. With the increased education has come means of attracting young students through various financial methods of support while attending school.

1221. Sanitary Engineering Education: Industrial Hygiene Engineering, by Alvin F. Meyer, Jr. (SA) As a segment of sanitary engineering, industrial hygiene imposes certain education requirements which must be satisfied before the engineer is qualified to solve industrial health problems. The questions of where industrial hygiene education fits into the over-all sanitary engineering education and what is required are discussed.

1222. Sanitary Engineering Education: Air Pollution Engineering, by Harvey F. Ludwig and Frank A. Butrica. (SA) The increased importance of air pollution in modern technology is creating problems which must be solved. At the present time the sanitary engineering education falls short of preparing the engineers for solving air pollution problems. A new curriculum for specialists in air pollution is outlined.

1223. Sanitary Engineering Education: Industrial Wastes Engineering, by Ross E. McKinney. (SA) The current sanitary engineering education, with its undergraduate civil engineering and graduate sanitary engineering, fails to train engineers to solve industrial waste problems. The best background lies in chemical engineering or in the new biochemical engineering.

1224. Sanitary Engineering Education: ICA Assistance in Peru, by Marvin L. Granstrom. (SA) The United States, through the University of North Carolina School of Public Health and under the assistance of the International Cooperation Administration, has undertaken the task of assisting the Universidad Nacional de Ingenieria, Lima, Peru, in developing an adequate sanitary engineering program.

1225. Discussions of Proceedings Papers 959, 1089. (PO) Andre Coyne closure to 959. Robert C. Price and T. G. Swennes on 1086.

1226. Discussions of Proceedings Paper 867. (WW) E. D. Butcher, Bailey T. Bardeleben on 867. Willard P. McCrone closure to 867.

1227. Discussions of Proceedings Papers 885, 928, 1002, 1078, 1083, 1115, 1172. (SA) V. B. Lamoureux closure to 885. Corrections to 928. Gerald T. Orlob and Robert G. Butler closure to 1002. Ralph Porges on 1078. Claes N. H. Fischerstrom on 1083. Thomas R. Camp on 1115. Corrections to 1172.

1228. Discussions of Proceedings Papers 934, 940, 1079, 1080, 1081, 1145, 1160. (SM) Charles R. Foster and W. J. Turnbull closure to 934. James F. McNulty closure to 940. Yoshichika Nishida, S. F. Gisienski on 1079. John A. Focht, Jr. on 1080. Ralph F. Reuss; R. B. Peck, M. T. Davisson, and Vello Hansen; Raymond Lundgren; Lymon C. Reese; E. A. Ripperger; Hudson Matlock on 1228. A. Warren Simonds on 1145. T. H. Wu on 1160.

1229. Discussions of Proceedings Papers 945, 1032. (EM) H. A. Einstein and Huon Li closure to 945. Corrections to 1032. William Zuk closure to 1032.

1230. Discussions of Proceedings Papers 668, 953, 1006, 1038, 1077, 1082, 1114, 1157. (HY) Norman H. Brooks closure to 668. Enos J. Carlson and Carl R. Miller closure to 953. L. J. Tison on 1006. Francis F. Escoffier closure to 1006. M. B. McPherson and R. G. Dittig; F. Paderi on 1038. Ven Te Chow on 1077. Mikhail S. Hanna; M. Gamal Mostafa; Y. M. Simaika and N. Boulos on 1082. Ven Te Chow on 1114. Corrections to 1157.

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Index to Advertisers

Acker Drill Company, Inc. 149
Aero Service Corporation 104
Wm. Ainsworth & Sons 26
Allis-Chalmers Manufacturing Company . . . 18, 19 and 107
Alster & Associates, Inc. 139
American Bitumuls & Asphalt Company 89
American Bridge Division 132
American Dewatering Corp. 85
American-Marietta Company 120
American Steel & Wire Division . . . . . 8, 9, 70 and 71
Armco Drainage & Metal Products, Inc. 105
Aurora Pump Division, The New York Air Brake Company 147

Barco Manufacturing Company 87
Bethlehem Steel Company . . . . . 4 and 111
Blaw-Knox Company 6
Boeing Airplane Company 127
Borden Metal Products Company 2
Bristol Steel & Iron Works 20
Brown & Brown 138
Builders-Providence, Division of B-I-F Industries, Inc. 21 and 145

Cast Iron Pipe Research Association . . . . . 10 and 11
Caterpillar Tractor Co. . . . . 12, 13, 96, 97 and 122
Centriline Corporation 25
Chicago Bridge & Iron Co. 27
Columbia-Geneva Steel Division . . . . . 8, 9, 70 and 71
Concrete Reinforcing Steel Institute . . . . . 14 and 146
Connors Steel Division, H. K. Porter Co., Inc. 144

Eugene Dietzgen Company 150
F. W. Dodge Corporation 28
E. I. du Pont de Nemours & Co., Inc. 126

Edo Corporation 129
Electrovert, Ltd. 112

Fairchild Aerial Surveys, Inc. 24
Fennel Instrument Corp. of America 148
Filotecnica Salmoiraghi, Inc. 141
Food Machinery and Chemical Corporation, Florida Division 102
Franki Foundation Company 7

Gar-Bro Manufacturing Co. 108
Griffin Wellpoint Corp. 69
W. & L. E. Gurley 101

Infilco, Inc. 15
The Ingalls Iron Works Company 99
International Harvester Company . . 116, 117, 118 and 119
Irving Subway Grating Co., Inc. 150

Kern Instrument, Inc., ... 138
Kerrigan Iron Works, Inc. . . . . 16 and 17

Layne & Bowler, Inc. 23
Lehigh Portland Cement Co. 121
Leupold & Stevens Instruments, Inc. 143
Lincoln Electric Company 103
Lock Joint Pipe Company . . . . . 4th cover
Lone Star Cement Corp. 32

M & M Valve and Fittings Company 140
The Master Builders Co. . . . . 3rd cover
W. R. Meadows, Inc. 142
Moretrench Corporation 26

National Clay Pipe Manufacturers, Inc. 1
National Pool Equipment Co. . . . . 2nd cover
National Tube Division . . . . . 70 and 71

Opla Company 114
Ozalid, Division of General Aniline & Film Corporation 83

Phoenix Bridge Company 146
Pipe Linings, Inc. 114
Portland Cement Association 133
Pressure Concrete Company 139
Procter & Gamble Company 128

Raymond Concrete Pile Co. 5
Richmond Screw Anchor Company, Inc. 22
H. H. Robertson Company 130
John A. Roebling's Sons Corp. 81
The Ronald Press Company 138

Simplex Valve & Meter Company 115
S. Morgan Smith Co. 134
Solvay Process Division 129
L. Sonneborn Sons, Inc. 113
Sonoco Products Company 110
Spencer, White & Prentis, Inc. 145
J. S. Staedtler, Inc. 137
Standard Oil Co. (Ind.) 135
P. A. Sturtevant Co. 146
Sverdrup & Parcel, Inc. 126
Sverdrup & Parcel Engineering Co. 124

Tennessee Coal & Iron Division . . . . . 8, 9, 70 and 71
Thompson Pipe & Steel Company 147
Tinney Drilling Co. 150

Union Metal Manufacturing Co. 30
United States Steel Corporation . . . 8, 9, 70, 71 and 132
United States Steel Export Corporation 8, 9, 70, 71 and 132
United States Steel Supply Company . . . . . 70 and 71
Universal Atlas Cement Co. 109
Universal Form Clamp Co. 131

D. Van Nostrand Co. 141
Vibroflotation Foundation Co. 106
Vulcan Iron Works, Inc. 149

Warren-Knight Company 114
Western Electric Company 123
C. H. Wheeler Manufacturing Co. 148
The David White Instrument Co. 145
Wild Heerbrugg Instruments, Inc. 146

Professional Services . . . . . 153, 154 and 155

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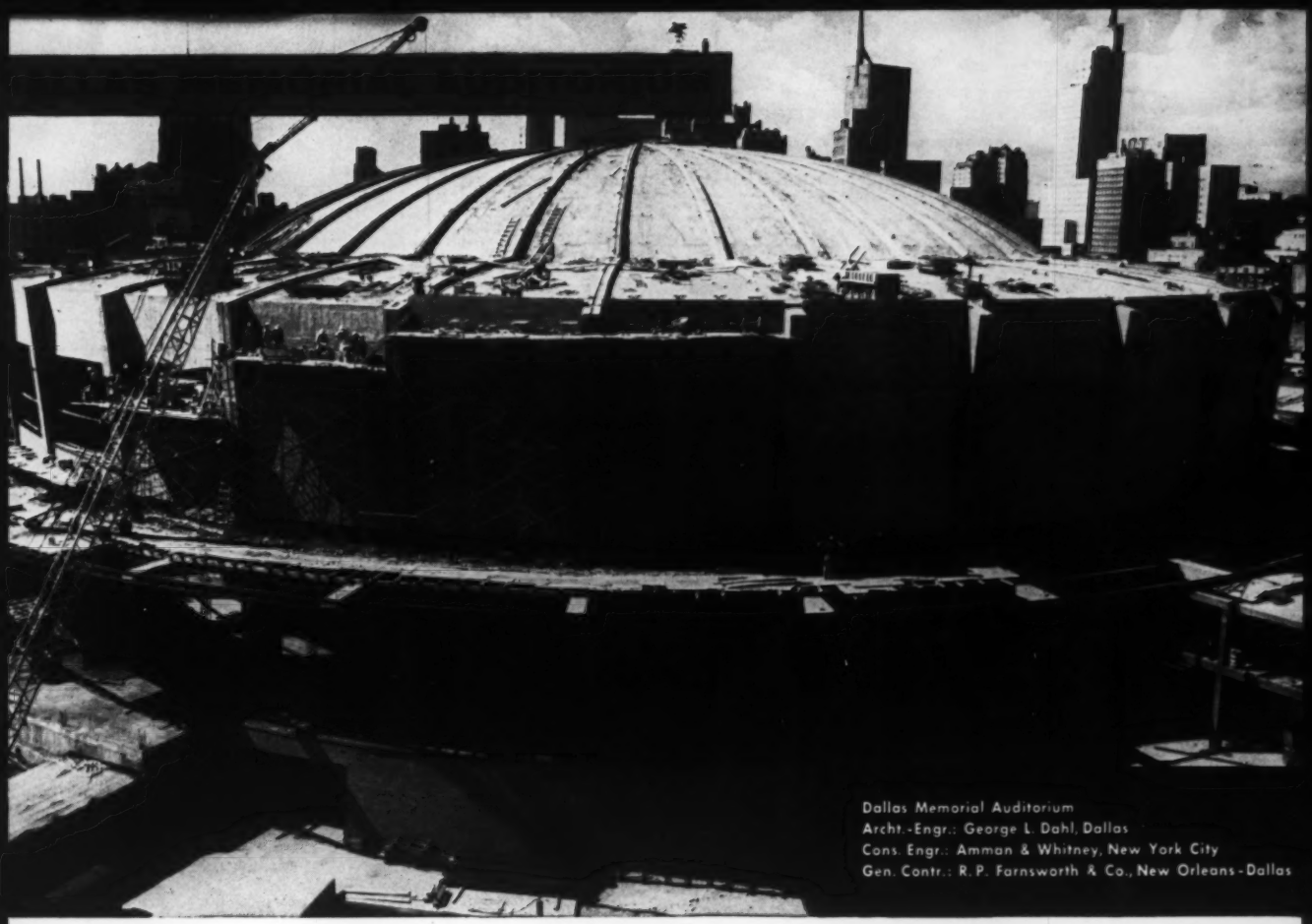

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